Remedial Investigation Report

West Lake Landfill
Operable Unit 1

Prepared For:

West Lake OU-1 Respondents Group

Prepared By:

Engineering Management Support, Inc.
12335 West 53rd Avenue, Suite 201
Arvada, Colorado 80002

April 10, 2000

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1.0 INTRODUCTION

This Remedial Investigation (RI) report has been prepared by Engineering Management Support Inc. (EMSI) on behalf of Cotter Corporation (N.S.L.), Bridgeton Landfill, LLC (formerly known as Laidlaw Waste Systems [Bridgeton], Inc.), Rock Road Industries, Inc., and the United Sates Department of Energy (the "Respondents"). The RI Report has been prepared as part of the Remedial Investigation/Feasibility Study (RI/FS) for Operable Unit (OU) -1 at the West Lake Landfill located in Bridgeton, Missouri. OU-1 addresses conditions associated with two areas of radiological impacted materials present at the West Lake Landfill, Radiological Area 1 (Area 1) and Radiological Area 2 (Area 2). Investigations and evaluations of the occurrences of non-radioactive constituents in other parts of the landfill are being performed by Bridgeton Landfill, LLC under a separate operable unit (OU-2) RI/FS.

The RI report for OU-1 at the West Lake Landfill has been prepared in accordance with the requirements of Administrative Order on Consent (AOC) between the U.S. Environmental Protection Agency (EPA) and the Respondents for OU-1. Specifically, this report presents the information required by Section 4.4.3 of the Remedial Investigation/ Feasibility Study (RI/FS) Statement of Work (SOW) to the AOC.

1.1 Purpose and Scope of the Remedial Investigation Report

The purpose of the RI report is to present the results of the various site characterization activities. As required by Section 4.4.3 of the SOW of the AOC, the RI report should summarize the results of the field activities conducted to characterize the following:

- Conditions at the site;
- The sources of contaminants;
- The nature and extent of contaminants and associated impacts; and
- The fate and transport of the contaminants.

Each of these requirements is addressed in later sections of this report.

1.2 Report Organization

The remainder of this report is organized as follows:

- Section 2 presents a summary of previous investigations;

- Section 3 presents a general description of the West Lake Landfill, its location and the characteristics of surface and subsurface features at the landfill;

- Section 4 describes the various investigations performed as part of the Remedial Investigation;

- Section 5 describes the physical characteristics of the West Lake Landfill;

- Section 6 describes the nature, occurrence and distribution of the sources of contamination associated with OU-1 including affected media, location, types of contamination, physical state of contaminants, contaminant concentrations and quantity of contaminants and affected media;

- Section 7 presents an evaluation of the fate and transport of the radiological contaminants including potential migration pathways and a description of the extent of migration, if any, along each pathway;

- Section 8 presents a summary of the non-radiological contaminants detected in Radiological Areas 1 and 2 and the various environmental media in the vicinity of these areas;

- Section 9 presents a summary of the results of the Baseline Risk Assessment which is included as Appendix A to the RI report;

- Section 10 presents a summary of the site conditions, a revised conceptual model of the occurrence of radiologically impacted materials and potential pathways through which radionuclides could migrate from Areas 1 and 2, and the estimated risks associated with occurrences of radionuclides onsite and potential offsite migration.

- Section 11 lists the various references used in completing this report.

The appendices that have been prepared as part of the RI report include the following:

Appendix A: Baseline Risk Assessment (prepared by Auxier & Associates)

Appendix B: Summary of soil sample radiological and non-radiological analytical results

Appendix C: Summary of groundwater sample radiological and non-radiological analytical results

2.0 SUMMARY OF PREVIOUS INVESTIGATIONS

Numerous reports on the conditions at the West Lake Landfill have previously been prepared. These include the following:

- Pre-RI reports,
- OU-1 RI/FS Work Plan and related documents,
- Investigation reports prepared as part of the OU-1 RI/FS,
- Work plan documents and site characterization reports prepared for OU-2,
- Reports prepared as part of the landfill development and operations, and
- Investigative reports associated with the buffer zone and Crossroad properties (formerly referred to as the Ford property) located immediately to the northwest of Area 2.

The specific reports that have previously been prepared and that were considered during the preparation of this RI are listed below.

2.1 Pre-RI Reports

The following reports were prepared prior to the initiation of the RI/FS activities for OU-1:

- Report of Site Visit - West Lake Landfill, St. Louis County, Missouri (Radiation Management Corporation, 1981)
- Radiological Survey of the West Lake Landfill, St. Louis County, Missouri (Radiation Management Corporation, 1982)
- Radioactive Material in the West Lake Landfill, Summary Report (U.S. Nuclear Regulatory Agency, 1988)
- Letter from Rodney Bloese to Joseph Homsy re: West Lake Landfill CERCLA dated December 12, 1989, (Foth & Van Dyke, 1989) (contains information on local water wells)
- Preliminary Health Assessment, West Lake Landfill, Bridgeton, St. Louis County, Missouri (Missouri Department of Health, 1991)

2.2 Operable Unit-1 RI/FS Work Plans

The following planning documents were previously prepared as part of the RI/FS for OU-1:

- RI/FS Work Plan for the West Lake Site, Bridgeton, Missouri, August 15, 1994 (McLaren/Hart, 1994),

- Amended Sampling and Analysis Plan, West Lake Landfill Operable Unit 1, February 29, 1997 (EMSI, 1997a),

- Responses to EPA's Comments on the Amended Sampling and Analysis Plan for Operable Unit 1, West Lake Landfill (EMSI, 1997e), and

- Draft Investigation Derived Waste Management and Interim Remedial Measures Plan, West Lake Landfill Operable Unit 1, September 1997 (EMSI, 1997d).

The RI/FS Work Plan was approved by EPA in September 1994 (EPA, 1994). The ASAP, although not formally approved, was submitted to EPA for review and comment and EPA's comments (EPA, 1997a and 1997b) and appropriate responses or modifications to the draft ASAP were provided to EPA (EMSI, 1997e). EPA subsequently provided verbal authorization to proceed with the ASAP activities. EPA provided comments on the Draft Investigation Derived Waste Management and Interim Remedial Measures Plan and responses to those comments and necessary modifications to the draft plan are still under development.

In addition, minor modifications to some of these plans were made and approved by EPA and/or their oversight contractor during the course of the field investigations. Many of these changes were documented in letters prepared by McLaren/Hart. Some of these changes were formally approved in letters from EPA. Where appropriate, these specific letters are referenced as part of the discussions of the various investigative activities contained in Section 4 of this RI report.

2.3 Operable Unit-1 Investigative Reports

The following investigative documents were previously prepared as part of the RI/FS for OU-1:

- Overland Gamma Survey Report, West Lake Landfill Radiological Areas 1 & 2, April 30, 1996 (McLaren/Hart, 1996a);

- Site Reconnaissance Report. West Lake Landfill Radiological Areas 1 & 2, May 16, 1996 (McLaren/Hart, 1996b);

- Threatened or Endangered Species Assessment Report, West Lake Landfill Radiological Areas 1 & 2, May 17, 1996 (McLaren/Hart, 1996c);

- Radon Gas, Landfill Gas and Fugitive Dust Report, West Lake Landfill Areas 1 & 2, November 22, 1996 (McLaren/Hart, 1996d);

- Rainwater Runoff, Erosional Sediment, Surface Water, and Leachate Sampling Data Report, West Lake Landfill Areas 1 & 2, November 22, 1996 (McLaren/Hart, 1996e);

- Split Soil and Groundwater Sampling Data Summary Report, West Lake Landfill Areas 1 & 2, November 22, 1996 (McLaren/Hart, 1996f);

- Groundwater Conditions Report, West Lake Landfill Areas 1 & 2, November 26, 1996 (McLaren/Hart, 1996g),

- Soil Boring/Surface Soil Investigation Report, West Lake Landfill Areas 1 & 2, November 26, 1996 (McLaren/Hart, 1996h),

- Interim Investigation Results Technical Memorandum, West Lake Landfill Operable Unit 1, January 28, 1997 (EMSI, 1997a),

- Site Characterization Summary Report, West Lake Landfill Operable Unit 1, August 1997 (EMSI, 1997c),

2.4 Operable Unit-2 Plans and Reports

The following investigative documents were previously prepared as part of the RI/FS for OU-2:

- Remedial Investigation/Feasibility Study Work Plan (Golder Associates, 1995a)

- Draft Hydrogeological Characterization Report for the Bridgeton Active Sanitary Landfill, Bridgeton, Missouri, September 1995 (Golder Associates, 1995b)

- Physical Characterization Technical Memorandum for the West Lake Landfill Operable Unit 2, Bridgeton, Missouri, November 1996 (Golder Associates, 1996a)

- West Lake Landfill, Operable Unit 2 RI/FS, Site Characterization Summary Report, December 1997 (Water Management Consultants, 1997)

2.5 Landfill Reports

The following reports were prepared in support of the ongoing landfill operations at the West Lake Landfill:

- Environmental Investigation and Health Impact Assessment, Bridgeton Sanitary Landfill, October 1993 (Golder Associates, 1993)

- Radiological Survey of West Lake Landfill Bridgeton, Missouri, June 4, 1996 (Golder Associates, 1996b)

2.6 Ford Property Reports

In addition to the studies of the Ford property (now the buffer zone and Crossroad property) discussed in the OU-1 investigative reports, the following reports have been prepared specifically for the Ford property located to the northwest and adjacent to Radiological Area 2:

- Phase II Investigation Report (Dames & Moore, 1990)

- Phase III Radiological Site Assessment, Earth City Industrial Park (Dames & Moore, 1991)

All of the above reports were reviewed during the preparation of this document. Information, data and interpretations from each report were incorporated as applicable. It should be noted that the discussion of the nature and extent of contamination presented in Sections 6 and 7 of this report is based primarily upon the data and results obtained as part of the OU-1 field investigations and laboratory analyses. Chemical and radiological results obtained as part of other investigations of the landfill, principally the pre-RI investigations and the OU-2 investigations, were evaluated and considered as part of the assessment of the nature and extent of contamination associated with Areas 1 and 2 for OU-1. These non OU-1 data were used to assess the representativeness of the OU-1 results. However, the non-OU-1 data generally were not tabulated or integrated into the statistical or other evaluations of the OU-1 data that form the principal basis for the evaluation of the nature and extent of contamination for OU-1.

3.0 SITE BACKGROUND

This section presents a brief description of the West Lake Landfill including its location, an overview of past and current landfill operations, and a discussion of activities occurring adjacent to the landfill.

3.1 Landfill Description and Location

The West Lake Landfill is located within the western portion of the St. Louis metropolitan area on the east side of the Missouri River. The landfill is situated approximately one mile north of the intersection of Interstate 70 and Interstate 270 within the city limits of the City of Bridgeton in northwestern St. Louis County.

The West Lake Landfill is an approximately 200-acre parcel containing multiple facilities. The primary facility, the Bridgeton Landfill (formerly known as the Laidlaw Landfill and before that as the West Lake Landfill) has an address of 13570 St. Charles Rock Road, St. Louis County, Missouri (Figure 3-2). St. Charles Rock Road (State Highway 180) borders the landfill on the north. Taussig Road and agricultural land lie to the southeast of the landfill. Old St. Charles Rock Road, along with undeveloped land, borders the southern and western portions of the landfill (Figure 3-2).

The West Lake Landfill includes an active solid waste landfill, an inactive demolition landfill, and an inactive sanitary landfill. In addition, included within the boundaries of the site as defined in the OU-2 Work Plan, are concrete and asphalt batch plants, an automobile repair shop and a former telephone switching station although these operations are not the subject of the RI/FS. Current surface ownership of the landfill property in the vicinity of Areas 1 and 2 is depicted on Figure 3-3.

A 6-foot high chain-link fence with a 3-strand barbed wire canopy encloses the entire landfill. The main access gate is located on the northeastern perimeter off of St. Charles Rock Road. An additional gate is located on the southwestern perimeter to provide access to the borrow area located across Old St. Charles Rock Road. A third gate provides access to the automobile repair shop.

The Earth City industrial park lies to the west and adjacent to the West Lake Landfill across Old St. Charles Rock Road. Previously undeveloped property now or formerly owned by Ford Financial Services Group (Ford property) lies immediately to the northwest of the landfill (Figures 3-2 and 3-3). Property to the north of the landfill, across St. Charles Rock Road, is moderately developed with commercial, retail and manufacturing operations. Zoning for the landfill and surrounding area is depicted on Figure 3-4.

A deed restriction was recorded in May 1997 against the entire landfill area prohibiting residential use and groundwater use. An additional deed restriction was recorded in January 1998 restricting construction of buildings and underground utilities and pipes within Areas 1 and 2. These deed restrictions cannot be terminated without the written approval of the current owners, MDNR and EPA.

3.2 Summary of Landfill Operations

The West Lake Landfill is comprised of approximately 200 acres. Limestone was quarried from the landfill area from 1939 to 1988. Beginning in the early 1950s or perhaps the late 1940s, portions of the quarried areas and adjacent areas were used for landfilling municipal refuse, industrial solid wastes and construction demolition debris. It has been alleged, but never substantiated, that liquid wastes were also placed in the landfill. These activities were not subject to State permitting, and the portion of the landfill where these activities occurred has been termed the "unregulated landfill". In 1974, a State landfill permit was obtained and landfilling began in the portion of the property described below as the North Quarry Pit. Landfilling continued in this area until 1985 when the landfill underwent expansion to the southeast in the area described below as the South Quarry Pit. Landfill activities conducted in 1974 and afterwards within the quarry area were subject to a permit from the Missouri Department of Natural Resources (MDNR) and hence this area is referred to as the "regulated landfill".

The landfill can be divided into the following six distinct areas (Figure 3-5):

- Radiological Area 1 within and adjacent to the North Quarry Pit inactive sanitary landfill
- Radiological Area 2 within the inactive demolition landfill
- Inactive demolition landfill (excluding Area 2)
- Inactive sanitary landfill
- North Quarry Pit inactive sanitary landfill (excluding Area 1), and
- South Quarry Pit landfill (the active sanitary landfill).

These six areas are briefly discussed below. There also is a surface water retention pond, abandoned leachate lagoons and an active leachate retention pond associated with the sanitary landfill operations. The focus of OU-1 is Radiological Areas 1 and 2 and the nearby Ford property which is adjacent to Area 2 (Figure 3-6).

3.2.1 Radiological Area 1

Radiological Area 1 is located immediately to the southeast of the landfill entrance. This area was part of the unregulated landfill operations conducted up through 1974. Based on the drilling logs obtained as part of the RI/FS investigations for OU-1, the waste materials within Area 1 consist of municipal refuse (sanitary wastes) with an average thickness of approximately 36 feet.

Area 1 consists of approximately 10 acres that may have been impacted by radiological materials (Fig 3-5). There is an asphalt entrance road and parking area located on the northwestern border of Area 1 near the landfill office building. The remaining portions of Area 1 are mainly covered with grass. An underground diesel tank is located beneath the asphalt-paved area in the western portion of Area 1. The tank is no longer in use but has not been removed because it is within the boundaries of Area 1.

3.2.2 Radiological Area 2

Radiological Area 2 is located in the northwestern part of the landfill. This area was also part of the unregulated landfill operations conducted up through 1974. Based on the drilling logs obtained as part of the RI/FS investigations for OU-1, the waste materials within Area 2 consist of construction and demolition debris and municipal refuse with an average thickness of approximately 30 feet.

Area 2 consists of approximately 30 acres that may have been impacted by radiological materials (Fig 3-5). Large portions of this area are covered with grasses, native bushes and trees while other portions are unvegetated and covered with soil, gravel, concrete rubble and miscellaneous debris consisting of concrete pipe, metal and automobile parts, discarded building materials, and other non-perishable materials. Scattered throughout Area 2 are a number of small depressions, some of which seasonally contain ponded water and phreatophytes such as cattails. The northern and western portions of Area 2 are bounded by the landfill berm, the slopes of which are covered with a dense growth of trees, vines and bushes.

3.2.3 Inactive Landfill Operations

In addition to Radiological Areas 1 and 2, an inactive demolition landfill and an inactive sanitary landfill area are located in the north central part of the landfill property. The inactive demolition landfill is located on the southeast side of Radiological Area 2, between Area 2 and the landfill entrance road. The inactive sanitary landfill is located to the southwest of the inactive demolition landfill. As with the landfill operations conducted in Areas 1 and 2, the operations performed in these areas were also part of the unregulated landfill operations conducted up through 1974. Wastes disposed of in these areas are believed to consist of sanitary wastes, a variety of other solid wastes and demolition wastes.

3.2.4 Current Active Landfill Operations

The north quarry pit and the south quarry pit are associated with current landfilling operations. Landfilling activities conducted in these areas are subject to a permit issued by MDNR in 1974. Extensive information is available regarding the operations conducted and the nature and configuration of the waste materials disposed of in these areas (McLaren/Hart, 1994). Disposal activities at the north quarry pit were previously completed and this area is currently inactive. Disposal activities are currently being conducted at the south quarry pit.

3.3 Activities Adjacent To The Landfill

The property located to the west of Area 2 (the buffer zone and Crossroad properties formerly referred to as the Ford property) was recently developed as an industrial park. The subdivision plat for the Crossroad property, known as Crossroads Industrial Park, currently reflects a 1.785-acre buffer created adjacent to the Area 2 slope. The buffer zone includes the area of radiologically impacted surface soils as identified in the "Phase III Radiological Assessment" performed by Dames & Moore for Ford Financial Services Group (Ford) in 1991. The boundary of the current buffer zone is shown on Figure 3-6. The Respondents and Ford are currently engaged in discussions that would result in transfer of the buffer zone ownership to one or more of the Respondents.

4.0 SITE INVESTIGATION ACTIVITIES

This section of the RI report describes and summarizes the results of the various site investigation activities performed in conjunction with the development of the RI/FS for OU-1. More detailed descriptions of the RI field investigations can be found in the various reports listed in Section 2 of this document and referenced in the following discussions. Table 4-1 presents a summary of the various investigative activities and the associated reports prepared by McLaren/Hart or EMSI.

4.1 Site Reconnaissance

McLaren/Hart completed a site reconnaissance to identify site features that may have changed since preparation of the Work Plan and to identify site conditions that may affect the remedial investigations and ultimately the development of remedial alternatives. McLaren/Hart prepared a report titled Site Reconnaissance Report - West Lake Landfill Radiological Areas 1 & 2 dated May 16, 1996 (McLaren/Hart, 1996 b), which was previously submitted to EPA.

4.1.1 Summary of Methods and Procedures Used

The site reconnaissance was completed on October 18, 1994, prior to the start of any of the sampling activities. Activities completed as part of the site reconnaissance included the following:

- Identification of any changed conditions that would affect the completion of the field activities;
- Identification of any planned or new residential or commercial construction;
- Examination of the soil cover and adjacent slopes in Areas 1 and 2 for evidence of potential hazardous chemicals;
- Evaluation of runoff and sedimentation patterns in and around Areas 1 and 2;
- Evaluation and selection of potential staff gauge locations and surface water sampling points;
- Inspection of all existing monitoring wells and evaluation of their suitability for water level measurements and groundwater sampling; and
- Inspection of the site for evidence of habitat for threatened or endangered species.

A more detailed description of the specific activities completed as part of the site reconnaissance effort as well as the methods used can be found in the Site Reconnaissance Report - West Lake Landfill Radiological Areas 1 & 2 dated May 16, 1996 (McLaren/Hart, 1996b).

4.1.2 Deviations from Work Plan

The RI/FS Work Plan did not specifically address procedures for site reconnaissance; therefore, no deviations from the Work Plan exist.

4.1.3 Summary of Results

Results of the site reconnaissance effort were previously presented in the Site Reconnaissance Report - West Lake Landfill Radiological Areas 1 & 2 dated May 16, 1996 (McLaren/Hart, 1996 b). A general summary of results of the site reconnaissance effort and the conclusions reached by McLaren/Hart are as follows:

- No changed conditions were identified by McLaren/Hart;
- No planned or new residential or commercial construction was identified by McLaren/Hart at the time the site reconnaissance was conducted (It should be noted that although not anticipated in 1994 at the time of McLaren/Hart's site reconnaissance, substantial new commercial building construction has occurred to the south and west of the landfill in the last twelve to eighteen months);
- No evidence of potential hazardous chemicals in Areas 1 and 2 was identified by McLaren/Hart;
- McLaren/Hart identified four locations from which runoff from Area 1 occurs. This runoff flows into the perimeter drainage ditch and ultimately into a closed topographic depression (the North Surface Water Body) near the northern portion of Area 2 (Figure 4-1);
- McLaren/Hart identified five locations from which runoff from Area 2 occurs. This runoff flows either to the North Surface Water Body, onto the Ford Property farmers field or out along the access road to Area 2 in the vicinity of the demolition landfill and the roll-off bin storage area;
- McLaren/Hart identified potential locations for the staff gauges and surface water sampling points within the North Surface Water Body and the flood control channel located along the western portion of the landfill. These locations were

presented to EPA in McLaren/Hart's March 30, 1995 letter (McLaren/Hart, 1995b) and were approved by EPA on May 5, 1995 (EPA, 1995a);

- McLaren/Hart inventoried all existing monitoring wells which could be located at the landfill, noted those wells with problems such as crushed or broken casings, re-surveyed the well locations and collar elevations, re-developed the existing wells and evaluated the suitability of the existing wells for use in water level measurements and groundwater sampling;

- McLaren/Hart located a number of cased soil borings used by Radiation Management Corporation during its investigations conducted in 1981; and

- McLaren/Hart performed an inspection of the landfill area for evidence of threatened or endangered species habitat (discussed below).

A more detailed description of the results of the site reconnaissance effort can be found in the Site Reconnaissance Report - West Lake Landfill Radiological Areas 1 & 2 dated May 16, 1996 (McLaren/Hart, 1996 b).

4.1.4 Data Quality Issues

McLaren/Hart identified no data quality issues in its report. EMSI also did not identify any data quality issues associated with the site reconnaissance effort.

4.1.5 Outstanding Issues or Items

McLaren/Hart did not identify any outstanding issues in its report for this activity. EMSI also did not identify any outstanding issues during our review of this activity.

4.2 Threatened or Endangered Species Assessment

McLaren/Hart completed an assessment of the potential for the presence of threatened or endangered species occurrences at the landfill. The purpose of this assessment was to identify and characterize the dominant plant communities and to assess the site for the presence of threatened or endangered species.

4.2.1 Summary of Methods and Procedures Used

The methods used by McLaren/Hart to complete this investigation included the following:

- Qualitative identification of dominant plant communities in Areas 1 and 2;
- Submission of a written request to the U.S. Fish and Wildlife Survey to investigate whether any listed or proposed species have been determined to be present in the area of the landfill; and
- Completion of a detailed field survey to investigate whether the Western Fox Snake, a Missouri State-listed endangered species, was present at the site.

A more detailed description of the specific activities completed as part of the threatened or endangered species assessment as well as the methods used can be found in the Threatened or Endangered Species Assessment Report - West Lake Landfill Radiological Areas 1 & 2 dated May 17, 1996 (McLaren/Hart, 1996c).

4.2.2 Deviations from Work Plan

The RI/FS Work Plan did not specifically address procedures for the Threatened and Endangered Assessment; therefore, no deviations from the Work Plan exist.

4.2.3 Summary of Results

Following the completion of the threatened or endangered species assessment, McLaren/Hart concluded that:

- Four dominant plant communities exist at the landfill, including a forested community, an old field community, a maintained field community, and a wetland type vegetated community (plant species that may be found in wetlands);
- Six small isolated areas in Area 1 (Figure 4-2) and ten small isolated areas in Area 2 (Figure 4-3) contain plant species that may be found in wetlands (wetland type vegetated community). These areas were located in small surface depressions in the surface of the landfill and are an artifact of landfill construction and settlement and the placement of perimeter berms which obstruct surface water flow, restrict off site flow of rainwater runoff, and lead to water ponding on the landfill surface cover;

- Given that the small isolated depressions within Areas 1 and 2 are generally less than one-tenth of an acre in size (actual size varies from 0.01 to 0.36 acres), they do not contain water except after a rainwater event, they do not appear capable of functioning together as a wetland complex and they are artifacts of landfill construction and subsequent subsidence, McLaren/Hart concluded that no further assessment of these areas was necessary or appropriate to determine whether any of these areas exhibit other necessary characteristics of a wetland; and

- Review of the US Fish & Wildlife Service and Missouri Department of Conservation databases along with the results of the field inspection did not indicate that any threatened or endangered species (including the Western Fox Snake) were present in the vicinity of the landfill; therefore, no further assessment activities were necessary.

A more detailed description of the results of the threatened or endangered species assessment can be found in the Threatened or Endangered Species Assessment Report - West Lake Landfill Radiological Areas 1 & 2 dated May 17, 1996 (McLaren/Hart, 1996c).

4.2.4 Data Quality Issues

McLaren/Hart identified no data quality issues in its report. EMSI also did not identify any data quality issues associated with the threatened or endangered species assessment.

4.2.5 Outstanding Issues or Items

McLaren/Hart identified no outstanding issues in its report nor were any identified by EMSI during our review of this activity.

4.3 Overland Gamma Survey

The purpose of the overland gamma survey was to delineate the approximate areal extent of Radiological Areas 1 and 2 and to identify areas of elevated gamma readings ("radiologically affected areas") for investigation during subsequent field activities. Information from the overland gamma survey was subsequently used in finalizing the locations of those soil borings and monitoring well installations that would be located in radiologically affected areas. McLaren/Hart prepared a report for this activity titled Overland Gamma Survey Report - West Lake Landfill Radiological Areas 1 & 2 dated April 30, 1996 (McLaren/Hart. 1996a).

4.3.1 Summary of Methods and Procedures Used

The overland gamma survey was completed by collecting near-continuous readings on an approximately 30 foot transect spacing. Readings were collected using a 2-inch by 2-inch sodium iodide detector. Measurements were also taken at eight potential background locations. The resulting data (56,736 readings) were evaluated and computer-processed by McLaren/Hart to depict the areal distributions of the resultant gamma readings based upon different assumed background levels.

4.3.2 Deviations from Work Plan

The main deviation from the RI/FS Work Plan was the change in the sampling density resulting from implementation of a near continuous readout procedure used for the overland gamma survey. Measurements were obtained at approximately every 1 to 2 seconds at a walking speed of approximately 2 feet per second as opposed to the collection of discrete measurement points proposed in the Work Plan. As a result, the sampling grid utilized during the field work changed from an approximate 30 by 30-foot grid to a 1 to 4-foot by 30-foot grid. Use of the continuous readout system also increased the number of measurement points from approximately 5,000 to over 50,000 measurements. EPA's oversight contractor approved this change in the field prior to onset of the field work.

In addition to the change in grid spacing, the following deviations to the overland gamma survey were also implemented after approval by EPA or its oversight contractor:

- The number of background sampling locations was increased from two to eight sites; and
- A hand-held Geiger Mueller counter was used to initially locate areas of elevated gamma readings.

4.3.3 Summary of Results

The results of the overland gamma survey are described in detail in the Overland Gamma Survey Report - West Lake Landfill Radiological Areas 1 & 2 (McLaren Hart, 1996a). Significant findings reached by McLaren/Hart include the following:

- Evaluation and comparison of the results from the eight background locations indicated a wide range of background values;

- A single "site specific" background value could not be derived because of the wide variation in background values. McLaren/Hart suggested a range between 10 and 20 micro-Rems per hour (μR/hr);

- The size of the areas defined, as two times background is dependent upon the assumed background value. McLaren/Hart prepared five different figures depicting the areas with gamma readings twice the background level based upon background values of 10, 12.5, 15, 17.5 and 20 μR/hr (Figures 4-4 through 4-8);

- McLaren/Hart concluded that the 17.5 and 20 μR/hr values are the most representative of background conditions based upon the generally known locations of the radiological materials at the landfill; and

- Based upon the overland gamma survey, McLaren/Hart identified locations to advance soil borings to collect vertical profiles of the radiologically impacted materials.

4.3.4 Data Quality Issues

McLaren/Hart identified no data quality issues in its report. EMSI also did not identify any data quality issues during review of this activity.

4.3.5 Outstanding Issues or Items

McLaren/Hart identified no outstanding issues in its report. EMSI did not identify any data quality issues during our review of this activity. *If used alone without* the use of other site data, the inability to derive a single background number could result in uncertainties in deriving representative material volumes during the preparation of the FS. However, when the overland gamma results are used in conjunction with the results of the soil boring, down-hole gamma logging and soil sampling and analysis results, it is EMSI's opinion that representative and generally reliable estimates of the approximate volumes of impacted materials can be developed. These estimates are presented in Section 6 of this RI report.

It should be noted that the Overland Gamma Survey by itself may not completely define the areal extent of radiologically impacted areas. Information obtained from the Overland Gamma Survey should be used in conjunction with other information such as soil sample analyses and downhole gamma log results to assess areas potentially impacted by radonuclides.

4.4 Surface and Subsurface Soil and Perched Water Investigations

This section describes the surface and subsurface soil investigation activities including surface geophysical investigations, landfill gas surveys, borehole drilling, soil sample collection and chemical analyses, down-hole gamma logging, soil boring abandonment, and geotechnical sampling and testing. Also included in this section is a discussion of occurrences and sampling of perched water encountered during the soil-boring program.

4.4.1 Purpose and Scope of Investigation

The surface and subsurface soil and perched water investigation activities were completed to characterize the distribution and extent of radioactive and hazardous non-radioactive constituents within the landfill mass, including the various cover soils and potential perched water occurrences in Areas 1 and 2. McLaren/Hart completed or supervised all initial field activities and prepared a summary report titled Soil Boring/Surface Soil Investigation Report (McLaren/Hart, 1996h).

McLaren/Hart's investigation of the landfill soils and perched water included the following:

- Pre-screening of each soil boring location within the landfill for potential large metal obstacles and methane concentrations;
- Drilling of 20 borings in Area 1 and 40 borings in Area 2, including pre-drilling of all planned monitoring wells to be completed through areas underlain by landfill refuse. In addition, five hand borings were drilled and sampled in a closed topographic depression within Area 2;
- Collection of soil samples from all of the soil borings, generally at five-foot depth intervals, and performance of radiological and chemical analyses on selected soil samples from the various soil borings;
- Collection of samples from four background locations potentially representative of daily cover materials and performance of radiological and chemical analyses;
- Down-hole radiological logging of all of the newly drilled soil borings and of all existing monitoring wells and cased soil borings remaining from the prior site investigation (RMC, 1982) that could be located;
- Collection of selected perched water samples encountered during the soil boring activities; and

- Collection and laboratory testing for selected geotechnical properties of four soil samples obtained from the landfill slope at the northern edge of Area 2 above the former Ford Property.

Supplemental surface and subsurface soil investigation activities were conducted by EMSI as requested by EPA to assess the lateral extent of constituents in the southwestern portion of Area 1 and to further evaluate the lateral extent of surface and near subsurface constituents on the Ford Property. The supplemental activities were described in a letter to EPA (EMSI, 1997e), which responded to EPA's comments on the ASAP (EPA, 1997b), and included the following:

- Drilling of four borings in the southwestern portion of Area 1. The locations for these borings were developed using the same methodology as was used for selecting the random boring locations for the previous field investigation. Additional grids were added in the southwest corner of the of the existing grid system for Area 1. Surface samples were collected at each boring location and downhole geophysical logging was performed in each borehole. As elevated gamma levels were not encountered during the geophysical logging, no subsurface samples were collected. Radiological analyses were performed on the surface soil samples and the boring locations were surveyed.

- Additional surface and near surface samples were collected at eight locations on the Ford property. Surface samples were collected at a depth interval between 0 to 3 inches below ground surface (bgs) at each location. A hand auger was also advanced at each location and samples were collected from the hand auger boring at depth intervals of 3 to 6 inches, 6 to 12 inches, 1 to 2 feet, 2 to 3 feet, 3 to 4 feet, and 4 to 5 feet bgs. The surface sample and the sample from 1 to 2 feet from each location were analyzed for radionuclides. As the results of these analyses along with the results of the previous analyses performed by McLaren/Hart indicated that vertical extent of radionuclide occurrences did not extend below a depth of approximately six inches, the samples collected at the other depths were not analyzed.

4.4.2 Summary of Methods and Procedures Used

The methods and procedures used included: surface geophysical surveying; landfill vapor sample collection and field analysis; auger and mud rotary drilling and soil boring advancement; soil sample collection, chemical analysis of soil samples; perched water sample collection and chemical analysis; down-hole radiological logging; and soil-boring abandonment. Summary information on each activity is provided below. Detailed descriptions of each field activity and laboratory analysis conducted by McLaren/Hart are contained in the Soil Boring/Surface Soil Investigation Report (McLaren/Hart, 1996 h). Detailed descriptions of the supplemental field and laboratory activities conducted by

EMSI can be found in the letter from EMSI to EPA dated April 29, 1997 (EMSI, 1997e) and the Site Characterization Summary Report (SCSR) for OU-1 (EMSI, 1997c).

4.4.2.1 Surface Geophysical and Landfill Vapor Surveys

Surface geophysical surveying consisted of completing a non-intrusive total magnetic surface survey at each planned boring location within Areas 1 and 2 as proposed in the RI/FS Work Plan. The objective was to identify the spot within 30 feet of each proposed location within Areas 1 and 2 with the lowest potential for buried ferromagnetic debris. Final borings were then advanced at the selected locations. Geotechnology of St. Louis, Missouri using a GEM GSM-19 magnetometer/gradiometer, completed the surface geophysical survey.

Soil vapor samples were collected at depths of 5 and 10 feet at each proposed boring location in Areas 1 and 2 and analyzed for methane gas to determine the potential hazard posed by possible landfill gases at each proposed boring location. This activity and associated methodology was first described in the RI/FS Work Plan and the associated Sampling and Analysis Plan. GEO Environmental Testing under the supervision of McLaren/Hart completed the work. Further details related to the surface geophysical and landfill vapor surveys are presented in the Soil Boring/Surface Soil Investigation Report (McLaren/Hart, 1996h) and the Radon Gas, Landfill Gas and Fugitive Dust Report (McLaren/Hart, 1996d).

4.4.2.2 Soil Boring Drilling

The EPA approved RI/FS Work Plan called for a total of 50 soil borings to be drilled as part of the OU-1 field investigation. These fifty borings included 18 borings in Area 1 and 32 borings in Area 2. As part of the evaluation of the Overland Gamma Survey results (McLaren/Hart, 1996a), McLaren/Hart proposed minor modifications in the soil boring locations resulting in a total of 18 borings in Area 1 and 33 borings in Area 2 for a total of 51 soil borings. EPA subsequently approved these boring locations in its letter dated July 21, 1995 (EPA, 1995b).

A total of 20 soil boring locations were ultimately drilled by McLaren/Hart in Area 1 and 40 soil boring locations plus five hand-auger borings were drilled in Area 2 (Figure 4-9). These borings include two additional borings in Area 1 and seven additional borings in Area 2 beyond the number proposed in the Overland Gamma Survey report and subsequently approved by EPA. The additional borings were the result of encountering shallow perched water within the body of the landfill debris. To avoid creating a conduit for leachate migration, any boring that encountered perched water was abandoned prior to reaching total depth and a new boring was drilled outside of the area of perched water. In addition, at several locations, multiple borings were drilled due to encountering auger refusal at shallow depths within the landfill or to loss of the boring due to caving of the borehole walls or flowing sands encountered in the alluvial materials beneath the landfill deposits.

During the field investigation, 52 borings were actually drilled at or near the 51 locations proposed in the Overland Gamma Survey Report (McLaren/Hart, 1996a) as approved by EPA. An additional boring, WL-205, was drilled adjacent to boring WL-204 located on the Ford property. This additional boring was drilled as part of the pre-drilling of monitoring wells and as a result of occurrences of caving sands in alluvial materials encountered in boring WL-204 that prevented completion of boring WL-204 to the full depth originally intended.

The locations of six of the Area 2 borings, WL-212, WL-216, WL-217, WL-234, WL-235 and WL-236 were moved a significant distance (50 to 200 feet) during the field investigation. Boring WL-212 was moved approximately 50 feet to the southeast in response to field conditions. Boring WL-216 was originally located outside of Area 2 and was re-located to be within the boundary of Area 2. Boring WL-217, scheduled for installation of a monitoring well, was also originally located outside of the boundaries of Area 2. WL-217 was subsequently relocated to within the boundaries of Area 2. The remaining three of these borings (WL-234, WL-235 and WL-236) were moved back away from the edge of slope in the southwestern portion of the landfill for safety reasons.

In addition to the 51 soil boring locations proposed in the Overland Gamma Survey Report (McLaren/Hart, 1996a) and additional boring WL-205, two contingent borings (WL-118 and WL-119) were drilled in Area 1 and six additional soil borings were drilled in Area 2 (WL-228, WL-229, WL-237, WL-238, WL-240 and WL-241). The majority of these additional borings (WL-118 and 119 and WL-237, 238, 240, and 241) were drilled in response to the discovery of perched water in other borings. Two of these borings (WL-228 and 229) were drilled in conjunction with the installation of monitoring wells, the locations of which were re-located in response to field conditions necessitating acquisition of subsurface information at the new locations of these wells. As a result, a total of 60 soil borings were drilled as part of the OU-1 RI field investigations.

In addition to the eight contingent soil borings, five additional hand-auger borings were advanced to depths of one to two feet in and around the closed topographic depression and the northern landfill berm in the northeastern portion of Area 2. These five hand-auger borings were recommended in the Overland Gamma Survey Report (McLaren/Hart, 1996a).

Three different drilling methods were utilized during the soil boring activities. Borings in areas underlain by landfill debris were advanced to the bedrock contact using a 24-inch diameter truck mounted auger. Borings in areas not expected to be underlain by landfill debris (i.e. the Ford property) were advanced with a hollow-stem auger drill rig. Contingency soil borings located in the closed topographic depression in the northern portion of Area 2 were manually advanced with a hand-auger. All of the drill rig advanced soil borings were drilled using the procedures proposed in the RI/FS Work Plan.

Organic vapor, explosive gas and radiological measurements were obtained in the field during the advancement of each soil boring using a photo-ionization detector (PID), an oxygen/combustible gas indicator, and a Geiger/Mueller instrument, respectively. Field measurements were generally made at 5-foot intervals during drilling and when visual changes in the drill cuttings were observed.

Detailed lithologic logs were prepared for each machine-advanced boring. The lithologic logs include descriptions of the soil and bedrock materials encountered and classification based on the Unified Soil Classification System. The soil boring logs along with additional details regarding the drilling procedures are presented in McLaren/Hart's Soil Boring/Surface Soil Investigation Report (McLaren/Hart, 1996a).

EMSI advanced an additional four soil borings on May 13 and May 14, 1997 according to the procedures contained in the approved ASAP. All four borings were advanced using hollow-stem auger until alluvial materials were encountered. Each boring was then logged using gamma-gamma and natural gamma tools. Soil samples were collected at the surface and submitted for radiological analysis. Subsurface samples were not submitted because neither clearly identifiable soil layers nor elevated downhole gamma readings were encountered in any of these four borings.

As part of the ASAP activities, eight hand-auger borings were drilled by EMSI to depths of 5-feet on the Ford property. Samples were obtained from these hand-auger borings from depth intervals of 0 to 3 inches, 3 to 6 inches, 6 to12 inches, 1 to 2 feet, 2 to 3 feet, 3 to 4 feet, and 4 to 5 feet below ground surface.

4.4.2.3 Soil Sample Collection and Chemical Analyses

Soil samples were collected from all of the soil borings. Surface samples were collected from 15 of the soil borings, five in Area 1 and ten in Area 2, as required by the RI/FS Work Plan. In addition, surface samples were collected from the five hand-auger borings. Surface soil samples obtained from the machine-drilled borings were collected from the upper two inches of soil material, except for those samples collected for volatile organic compound (VOC) analyses which, due to volatilization potential, were obtained from a depth of 18 to 24 inches below ground surface. Subsurface samples were collected at 5-foot intervals from the large-diameter (24-inch) and hollow-stem auger borings. Samples were collected directly from the tip of the large-diameter auger or with split-spoon samplers in the case of the hollow-stem augers. Samples from the hand-auger borings in the closed topographic depression in the northern portion of Area 2 were obtained using a split-spoon sampler from the surface to a depth of two feet. All samples were placed in sealed plastic bags and labeled with the sample number and other identifying information immediately upon sample collection.

Soil samples were also collected from four background locations in accordance with McLaren/Hart's letter of September 12, 1995 (McLaren/Hart, 1995e) as approved by EPA in their letter of September 21, 1995 (EPA, 1995d). The four locations from which background samples were obtained included:

- Loess material present in the borrow pit area;
- Shale material present in the landfill soil borrow pit area (Note: This shale was incorrectly by McLaren/Hart and referred to in the McLaren/Hart reports as the Ladonda Shale. There is no Ladonda Shale present in Missouri but there is a Lagonda Formation which contains shale; however, this formation is much higher stratigraphically and therefore not present at the Site. The shale material present in the landfill soil borrow pit from which McLaren/Hart obtained its sample is actually part of the Cheltenham Formation);
- The western, non-impacted portion of the Ford property farmers field; and
- From an area adjacent to the McLaren/Hart shop located across St. Charles Rock Road from the landfill.

Background samples were collected from depths of six to twelve inches using a trowel.

In accordance with the requirements of the RI/FS Work Plan, two samples per boring were selected for radionuclide analysis. All fifteen of the surface soil samples were analyzed for radionuclides. Subsurface samples were selected based on the results of the down-hole radiological logging described below. Specifically, the subsurface sample obtained from the depth interval nearest to the depth of the gamma log peak was generally submitted for radiological analyses. Samples selected for radiological analyses were transferred from the labeled plastic bags to appropriate glass containers and recorded on the chain of custody form.

Quanterra Environmental Services (Quanterra) performed all radiological analyses in their St. Louis, Missouri laboratory. In addition, ten split-samples were independently analyzed by Accu-Labs Research (Accu-Labs) in their Golden, Colorado laboratory. The specific split samples were selected after review of the initial soil analyses performed by Quanterra. A detailed discussion of the split sampling activities and results is presented in the Split Soil and Groundwater Sampling Data Report - West Lake Landfill Areas 1 & 2 (McLaren/Hart, 1996f).

Radiological analyses of the soil samples were performed using National Academy of Sciences (NAS) or EPA methodologies as prescribed by the RI/FS Work Plan and associated Sampling and Analysis and Quality Assurance Plans. Appendix B of this RI contains a summary of the results of the radiological analyses of soil samples. Copies of the analytical laboratory reports for the soil samples were included in the Soil

Boring/Surface Soil Investigation Report (McLaren/Hart, 1996h). Quanterra also performed duplicate radiological analyses on 10% of the soil samples. With the exception of some minor differences discussed below in Section 4.4.3 of this report, soil sampling and analysis activities were conducted in accordance with the protocols described in the RI/FS Work Plan and the associated Sampling and Analysis and Quality Assurance Plans.

In addition to the radiological analyses, selected soil samples were also analyzed for organic and trace metal priority pollutants and other chemical parameters. Surface soil samples for priority pollutant analyses were collected from fifteen of the soil borings. As previously discussed, surface soil samples were generally collected from a depth of two inches except for samples for VOC and SVOC analyses which were collected from a depth of 18 to 24 inches due to the potential for volatilization. Results of both the radiological and non-radiological analyses of the soil samples are presented in Appendix B.

In addition to the 15 surface samples collected for priority pollutant analyses, selected subsurface soil samples were also obtained for priority pollutant analyses. In general, subsurface samples for priority pollutant analyses were obtained at the bottom of selected borings in the lower portion of the landfill debris, generally at the same depth as the lowermost radiological sample collected in each boring. Based on visual observations, soil samples were also collected from other depths in some of the borings for priority pollutant analyses. In the event of collection of a contingent soil sample based on visual or other observations, a second sample was collected for priority pollutant analysis from a depth interval below the depth that triggered collection of the contingency sample. In total, 25 subsurface soil samples plus three duplicate samples were submitted for organic priority pollutant analyses and 19 subsurface samples plus three duplicates were submitted for inorganic (trace metal) priority pollutant analyses.

Priority pollutant analyses were performed by MBT Laboratory, Rancho Cordova, California (MBT) in accordance with standard EPA methods for soil samples as described in the RI/FS Work Plan and the associated Sampling and Analysis and Quality Assurance Plans. Duplicate analyses were performed on 10% of the soil samples and matrix spike and matrix spike duplicate analyses were obtained from 5% of the samples. Duplicate and spike samples were randomly selected prior to the start of the drilling program. As agreed to by EPA, split sample analyses for priority pollutants were not conducted using the soil samples as the decision to obtain split samples was made after the holding times for most of the analyses had been exceeded.

Surface samples were collected from each of the four May 1997 ASAP boring locations. These samples along with one duplicate were submitted to Quanterra Laboratories for analyses for the radionuclides analyzed by McLaren/Hart during the RI field program. Surface samples (0 to 3 inch depths) and samples from the 1 to 2 foot depth intervals obtained from the hand-auger borings drilled by EMSI on the Ford property were also submitted to Quanterra for radiological analyses.

4.4.2.4 Perched Water Sample Collection and Analyses

Perched water was encountered at shallow depths within the landfill debris in eight of the 60 soil borings. Perched water was encountered during the drilling of two of the 20 borings in Area 1 (WL-108 and WL-116) and in six of the 40 borings in Area 2 (WL-208, WL-209, WL-210, WL-214, WL-226, WL-227 and WL-230). Perched water was encountered at depths of 12 feet in WL-108 and at 8 feet in WL-116. Perched water was encountered at depths of 6 feet in WL-215 and at 4.5 feet in WL-240 in the northeastern portion of Area 2 and at 12 feet in WL-217 in the south-central portion of Area 2. Perched water was also encountered at a depths of 21 and 23 feet respectively in borings WL-219 and WL-220 in the southwestern portion of Area 2 and at a depth of 31.5 feet in boring WL-231 in the northern portion of Area 2.

Based on the depths that the perched water was encountered and the proximity of the various boreholes in which the perched water was encountered, McLaren/Hart (1996e) identified five distinct bodies of perched water in the landfill, one in Area 1 and four in Area 2 (Figure 4-10). Overall, the presence of perched water appeared to be very limited and isolated in nature.

When perched water was encountered, the soil boring was terminated at a depth of approximately five feet below the depth at which the perched water was encountered. Perched water samples were then collected from four of the open borings (WL-108, WL-219, WL-220, and WL-231) using a disposable bailer or a decontaminated 5-gallon bucket attached to the bottom of the Kelly bar of the drill rig. After collection of the perched water sample, the boring was then abandoned and a new boring was drilled outside of the presumed extent of the perched water.

The EPA approved RI/FS Work Plan called for collection of perched water samples but no specific requirements were established for analytical testing. The four perched water samples were analyzed for radionuclides and three of these samples were analyzed for priority pollutant organic and trace metal parameters and leachate indicator parameters (biological oxygen demand, chemical oxygen demand, pH, total dissolved solids, total organic carbon, chlorides, nitrite, nitrate, ammonia, total phosphorous, and sulfide). Radiological analyses were performed by Quanterra and priority pollutant analyses were performed by MBT in accordance with the standard methods and procedures for water samples described in the RI/FS Work Plan and the associated Sampling and Analysis and Quality Assurance Plans.

One of the perched water samples (from WL-108) obtained from the perched water body in Area 1 was submitted for radiological and chemical analyses. Another sample was collected (WL-231) from a small body of perched water located in the northernmost portion of Area 2 just south of the north surface water body. This sample was also submitted for chemical and radiological analyses.

By far the largest body of perched water identified by McLaren/Hart was located in the westernmost portion of Area 2. Two samples of this perched water (from WL-219 and WL-220) were submitted for radiological analyses and one sample (WL-219) was submitted for chemical analyses. In addition, this body of perched water was also interpreted by McLaren/Hart to be the source of the landfill seep located near the northern end of the western boundary of the landfill. A sample of this seep was also collected and submitted for radiological and chemical analyses. The results of the analyses of this seep sample are presented in the Rainwater Runoff Report (McLaren/Hart, 1996e).

Two other small bodies of perched groundwater were encountered in Area 2 (WL-215 and WL-240, and WL-215) near the center of the landfill. Samples were not obtained from these areas. These perched waters occur as small, isolated bodies located near the center of the landfill and therefore are not directly subject to potential off-site discharge. In addition, no underlying groundwater impacts were detected in nearby monitoring wells D-13 or S-10, I-11 and D-12. Therefore, the lack of chemical and radiological analyses from these two small perched water bodies does not impact the RI/FS objectives or the completion of the RI/FS.

4.4.2.5 Down-Hole Radiological Logging

Down-hole radiological logging was performed at the completion of each soil boring and pre-drilled monitoring well location. All accessible cased soil borings and monitoring wells from the earlier RMC investigation (RMC, 1982) identified in Areas 1 and 2 were also logged.

McLaren/Hart used a Mount Sopris MGX digital logger and a combination Stratigraphic Gamma/Electric Probe instrument to perform the logging. All logging activities were completed according to the protocols presented in the RI/FS Work Plan with the minor exceptions noted below. Detailed information regarding the downhole radiological logging of the soil borings is presented in McLaren/Hart's Soil Boring/Surface Soil Investigation Report (McLaren/Hart, 1996h).

EMSI also used a Mount Sopris MGX digital logger and a combination Stratigraphic Gamma/Electric Probe instrument to perform the logging of the four borings drilled as part of the ASAP implementation. All logging activities were completed according to the protocols presented in the RI/FS Work Plan with the minor exceptions noted below.

4.4.2.6 Soil Boring Abandonment

Upon completion of the drilling and sampling activities conducted by McLaren/Hart, all of the soil borings, except for those used for construction of monitoring wells, were abandoned. Boring abandonment followed the procedures presented in the EPA approved RI/FS Work Plan except for a change in the composition of the grout mix used to abandon the large diameter borings (McLaren/Hart, 1995d). The Missouri Department of Natural Resources approved this change and granted a variance (MDNR, 1995) in advance of the implementation of this revised procedure. After back filling, all of the soil boring locations were surveyed for location. Exceptions included WL-110 that was obstructed by equipment at the time the survey was performed and the hand auger borings, which were drilled after the surveying activities had been completed.

All four of the borings advanced by EMSI were also abandoned using the procedures presented in the EPA approved RI/FS Work Plan.

4.4.2.7 Geotechnical Sampling and Testing

The RI/FS Work Plan, specifically the Sampling and Analysis Plan (SAP), required that a geotechnical investigation be conducted to evaluate the stability of the slope (berm) on the north side of Area 2. This area was subjected to significant erosion loss (referred to in the AOC SOW and RI/FS Work Plan as a "slope failure"). This erosional loss occurred prior to 1987 and may have resulted in transport of soil, some of which potentially contained radionuclides, from Area 2 down onto the adjacent Ford property to the edge of an area utilized for farming.

The SAP required collection of a minimum of four samples using a hand-held sampler from the face of the slope and also from one boring drilled at the top of the landfill or alternatively a surface sample from a location outward from the toe of the slope. The SAP also required field mapping to profile the slope at several locations and visual evaluation of any portions of the slope that have been exposed due to sloughing or erosional scour. The soil samples obtained through this effort were to be tested for moisture content and direct shear strength to evaluate the strength characteristics of the soil cover and the soils contained within the landfill.

McLaren/Hart drilled soil boring WL-208 at the top of the landfill and boring WL-206 at the base of the landfill slope in this area. Soil samples were obtained from these borings and submitted for chemical and radiological analyses but samples from these borings were not submitted for geotechnical testing. Four surficial soil samples were obtained from the slope area in the vicinity of weir 5 and tested for moisture content and three of the samples were tested for bulk density and dry density (the fourth sample was considered to be disturbed). Only one of these samples was tested for direct shear strength. Shannon & Wilson Inc. at their St. Louis, Missouri laboratory, performed all of the geotechnical tests. McLaren/Hart also attempted to perform a visual inspection of the landfill slope but dense vegetation along the slope prevented meaningful inspection. Although McLaren/Hart performed the geotechnical testing, the results of this investigation were not included in any of the McLaren/Hart data reports. Therefore, a copy of Shannon & Wilson's report was included as Attachment A to the IIR Technical

Memorandum (EMSI, 1997b). The results of this testing were also discussed in the Site Characterization Summary Report (EMSI, 1997c).

The geotechnical data developed by McLaren/Hart were not sufficient to perform a slope stability analysis of this area. Based on discussions with EPA, it was decided that rather than perform additional field work to address the stability of this slope, the Respondents would agree to regrading of this slope, through either excavation or placement of additional fill materials, as part of any remedy that may be selected for OU-1. Regrading of this slope to a lower angle obviated the need for additional investigative and testing activities. This approach was accepted and agreed to by EPA.

4.4.3 Deviations from Work Plan

McLaren/Hart or EMSI noted the following deviations from the approved RI/FS Work Plan:

- Samples of perched water were collected from the open hole with a bailer or bucket rather than with a Hydropunch™ as prescribed by the RI/FS Work Plan;

- The size of the sodium iodide detector used for the downhole logging was 3-15/16 inches by 1-1/8 inches rather than the 3/8 inch by 3/8 inch as proposed in the RI/FS Work Plan;

- McLaren/Hart did not state in the report if a collimeter was used as proposed in the RI/FS Work Plan;

- McLaren/Hart used a photo-multiplier tube in the down-hole radiological survey. This tool was not included in the RI/FS Work Plan; and

- Geotechnical testing was not performed on a sample obtained from the boring at the top of the landfill slope or from the surface at the toe of the landfill slope and only one of the four surface samples from the landfill slope were subjected to direct shear testing. (Please note prior discussion describing modifications to the approach for evaluation of the landfill slope as agreed to by EPA).

The RI/FS Work Plan called for collection of samples using a Hydropunch™ sampler of perched groundwater that may be encountered during drilling of the soil borings. Perched water was encountered during the drilling of some of the soil borings in Areas 1 and 2. Due to the large diameter of the soil borings combined with the need for large volumes of water for laboratory analyses, samples of perched water were obtained directly from the boring using a bailer or bucket rather than using a Hydropunch™ sampler. This field change did not affect the quality of the resultant data.

Although the Work Plan called for use of a 3/8-inch by 3/8-inch sodium iodide detector for use in downhole logging of the soil borings, a 3-15/16 inch by 1-1/8 inch detector was actually utilized in the field. This change did not affect the quality or use of the resultant downhole geophysical logs.

The Work Plan called for the detector used in the geophysical logging to be equipped with a collimeter to insure that it was positioned as near to the wall of the soil boring as possible. Although McLaren/Hart did not state in the soil boring report whether a collimeter was used, review of the downhole geophysical logs indicates that the logging was able to detect the presence of the radiologically impacted materials in most of the borings. In addition, McLaren/Hart added a photomultiplier tube to the logging equipment. Addition of this tool did not adversely effect the resultant downhole logging results.

As indicated in the Interim Investigation Results Technical Memorandum (EMSI, 1996a) and as discussed above, all of the testing and evaluations associated with assessing the stability of the landfill slope were not performed as part of the soil investigation activities. Based upon discussions with EPA, it was decided that the Respondents would regrade this slope to a lower overall slope angle, either by excavation or through placement of additional fill materials, as part of any remedy that may be selected for OU-1. Regrading of this slope to a lower angle obviated the need for additional investigative and testing activities. This approach was accepted and agreed to by EPA.

These deviations either improved or had no effect on the quality of the data obtained by the soil investigation or on the ability of the investigation to achieve the data quality objectives for this work.

In addition to the deviations noted above, subsurface soil samples were not collected by EMSI from the four soil borings drilled by EMSI in May 1997 as part of the Amended Sampling and Analysis Plan (ASAP). Although collection of subsurface soil samples for radiological analyses were specified in the ASAP, discrete layers of soil were not encountered in these borings. In addition, elevated downhole gamma readings were not detected during the geophysical logging of these borings. As a result, soil samples were not obtained and submitted for radiological analyses from these borings. The purpose of these borings was solely to further define the extent of the radiological material occurrences in the western portion of Area 1. Given the lack of elevated downhole gamma readings in these borings, we have concluded that the radiological material occurrences do not extend to the west or south of boring WL-105.

4.4.4 Summary of Results

A large volume of data was generated as a result of the soil boring and sampling efforts and is presented in the Soil Boring/Surface Soil Investigation Report

(McLaren/Hart, 1996h) and the SCSR (EMSI, 1997c). Significant observations with respect to site setting, radiological constituents, non-radiological constituents, and perched water based upon the data collected are described in the following subsections. Results of the laboratory analyses of the soil samples obtained during the RI are presented in Appendix B and results of the radiological analyses of the samples of perched water encountered in some of the soil borings are presented on Table C-17 in Appendix C.

4.4.4.1 Landfill Setting

McLaren/Hart made the following observations regarding the general site geologic and hydrogeologic conditions and the nature and configuration of the landfill debris:

- The thickness of the landfill materials varies from 20 to 56 feet in Area 1 and from 11 to 45 feet in Area 2;
- Loess (silt, clay and fine sand) is believed to have been representative of the materials used to cover the landfill debris in Areas 1 and 2;
- Isolated occurrences of perched groundwater were found to be present within the landfill debris and where present, perched water was found to be of very limited extent; and
- Regional (continuous) groundwater generally occurs in the unconsolidated alluvial deposits present below the base of the landfill debris.

4.4.4.2 Radiological Constituents

McLaren/Hart made the following general observations regarding the occurrences of radiological constituents within the landfill debris:

- The background radionuclide levels in this area are generally consistent with those measured at other sites in the State of Missouri;
- Elevated gamma counts (greater than 6,000 counts per minute) were measured in 35 percent of the soil borings in Area 1. Elevated counts were generally measured at depths ranging from 0 to 11 feet below ground surface (bgs). The thickness of materials with elevated readings generally varied between 1 and 5 feet; however, a 10.5-foot thickness was measured at one location (WL-105). Elevated downhole gamma readings were measured at both of the locations (WL-106 and WL-114/WL-118) that displayed high overland gamma readings during

the McLaren/Hart overland gamma survey (McLaren/Hart, 1996a). Neither elevated overland gamma readings, elevated downhole gamma results, nor elevated radionuclides in soil samples were detected at boring location WL-115 which was drilled in an area previously identified by RMC (1982) as containing high overland gamma readings.

- Elevated gamma counts were measured in 36 percent of the soil borings in Area 2. Elevated counts were generally measured at depths ranging from 0 to 16 feet bgs. The thickness of materials with elevated readings generally varied between 1 and 5 feet; however, between 10 and 12 feet of materials with elevated readings were measured at two locations (WL-210 and WL-211). Elevated downhole gamma readings were measured at two (WL-209 and WL-210) of the three locations (WL-208, WL-209 and WL-210) that displayed elevated gamma readings in McLaren/Hart's overland gamma survey (McLaren/Hart, 1996a). Elevated downhole gamma readings were also measured at location WL-234 where elevated overland gamma readings had previously been measured by RMC (1982); however, the high overland gamma readings detected by RMC were not detected at this location during the McLaren/Hart overland gamma survey;

- At the Ford property, elevated gamma counts were only measured in the surficial materials and were not found to be present in the subsurface soils;

- Soil results greater than reference levels (background plus 5 pCi/g for surface soil samples – see also the discussion of reference levels presented in Section 6.3 of this report) were measured in the surface samples at two of the five locations in Area 1 (WL-106 and WL-114) from which surface samples were obtained for radionuclide analyses;

- Radionuclides were detected in subsurface soil samples above reference levels (background plus 15 pCi/g for subsurface soil samples – see also the discussion of reference levels presented in Section 6.3 of this report) obtained from borings WL-106, WL-114, and WL-118 in Area 1. These were biased borings specifically located in areas displaying elevated overland gamma readings based on the McLaren/Hart (1996a) overland gamma survey. Elevated soil results were also detected subsurface soil samples from boring WL-105 although this boring location had been selected based upon installation of a monitoring well rather than on overland gamma survey considerations.

- Based upon the radiological data, McLaren/Hart concluded that the zone of radiological impacts in Area 1 is generally a thin layer (5-feet thick or less) in the upper part of the landfill debris;

- The radionuclides in the uranium-238 decay series are at secular equilibrium in the parts of Area 1 classified by McLaren/Hart as non-impacted zones while thorium-230 is above secular equilibrium levels in the impacted areas. Uranium-

235 levels are generally lower and not in secular equilibrium with the other constituents in this series in the impacted area. The constituents in the thorium-232 decay series were only detected in three borings located in areas of elevated gamma readings;

- For all three decay series, the radionuclide levels were generally measured above reference levels below ground surface in borings WL-206, WL-209, WL-210 and WL-234 in Area 2, the areas identified by McLaren/Hart as anomalous during the recent overland gamma survey. Elevated readings were also measured below current grade in WL-216; a location that McLaren/Hart concludes is associated with the radiologically affected area encountered in boring WL-210;

- Elevated readings were measured in the surface samples at three of the 15 locations in Area 2 (WL-206, WL-209, and WL-210) from which surface samples were obtained for radionuclide analyses;

- Based upon the radiological data, McLaren/Hart concluded that the zone of radiological impact in Area 2 is generally a thin layer (less than 5 feet) in the upper part of the landfill debris;

- The radionuclides in the uranium-238 decay series are at secular equilibrium in the parts of Area 2 classified by McLaren/Hart as non-impacted zones while thorium-230 is above secular equilibrium levels in the impacted zone. The uranium-235 levels are in secular equilibrium with the other constituents in the uranium-235 decay series in the non-impacted zone while the uranium-235 activity is generally lower and not in equilibrium in the impacted zone. The constituents of the thorium-232 decay series generally were detected only in isolated areas.

- Radiological levels in Area 2 are generally higher than the levels in Area 1; and

- McLaren/Hart reported problems with some of the thorium-230 data. Data quality issues associated with the throium-230 results are discussed in more detail in Section 4.4.5 of this report.

Detailed discussions of the radiological occurrences in Areas 1 and 2 and on the Ford property are presented in Section 6 of this report.

4.4.4.3 Non-radiological Constituents

The following general observations were made by McLaren/Hart regarding the occurrences of non-radiological (priority pollutant) constituents within the landfill debris:

- McLaren/Hart concluded that in Area 1 each of the trace metals are present at concentrations above the levels found in the background soils in one or more borings. The levels of trace metals detected in Area 1 soil samples are as follows:

Trace Metal	Background Value (mg/kg)	Range of Values Detected in Area 1 (mg/kg)
Arsenic	6.35	0.8-220
Beryllium	0.59	<0.25-3.3
Cadmium	<0.5	<0.5-7.9
Chromium	12.83	3.1-280
Copper	17.37	1.0-230
Lead	38.42	2.8-900
Mercury	<0.1	<0.1-0.17
Nickel	22.02	4.7-3600
Selenium	<0.25	0.25-250
Zinc	28.2	16-120

  The surface sample from boring WL-114 and the 5-foot sample from WL-115 contained the highest trace metal concentrations.

- McLaren/Hart also concluded that in Area 2 each of the trace metals are present at concentrations above the background soils levels in one or more borings. The levels of trace metals detected in Area 2 soils are as follows:

Trace Metal	Background Value (mg/kg)	Range of Values Detected in Area 2 (mg/kg)
Arsenic	6.35	0.7-35
Beryllium	0.59	<0.25-2.2
Cadmium	<0.5	<0.5-3.4
Chromium	12.83	2.0-890
Copper	17.37	1.0-360
Lead	38.42	<0.25-2,200
Mercury	<0.1	<0.1-0.27
Nickel	22.02	1.3-680
Selenium	<0.25	0.25-1.0
Zinc	28.2	<1.0-1,100

- Borings WL-206 (surface), WL-208 (20 feet), WL-209 (surface), and WL-210 (surface) contained the highest trace metal concentrations.

- Petroleum hydrocarbons were detected in borings WL-101, WL-106, WL-114, and WL-115 in Area 1. All concentrations were at or below 230 parts per million (ppm).

- Petroleum hydrocarbons were detected in borings WL-206, WL-208, WL-209, WL-210, WL-213, WL-214, WL-215, WL-218, WL-221, WL-222, WL-226, WL-227, WL-230, WL-231, WL-235 in Area 2. Gasoline concentrations varied from 240 to 2,600 ppm; diesel constituents ranged from 51 to 310 ppm; and motor oil constituents ranged from 19 to 3,100 ppm.

- Volatile organic compounds (VOCs), other than petroleum hydrocarbon constituents, were detected at concentrations generally less than 1 ppm in both Areas 1 and 2. The VOCs detected included aromatic hydrocarbons and ketones with isolated occurrences of methylene chloride, a known laboratory contaminant.

- Semi-volatile organic compounds (SVOCs), other than petroleum hydrocarbon constituents, were detected in both Areas 1 and 2 at concentrations generally less than 1 ppm.

- Pesticides were generally detected at concentrations less than 0.01 ppm. PCBs were detected in Area 1 at concentrations between 0.033 and 2.6 ppm. PCBs in Area 2 generally varied between 0.017 and 1.6 ppm; however, the sample from boring WL-218 contained PCBs at a concentration of 18 ppm.

- Based upon the non-radiological data collected, McLaren/Hart concluded that the presence and distribution of these constituents is limited in extent and isolated in nature. McLaren/Hart also stated that no correlation exists between the occurrences of radiological and non-radiological constituents.

4.4.4.4 Perched Water

McLaren/Hart made the following general observations regarding the occurrences of perched water within the landfill debris:

- The distribution of perched water is of limited extent and the various perched waters are isolated in nature (Figure 4-10).

- Uranium-238 decay series constituents were present in each of the perched water samples and the Area 2 seep.

- No uranium-235 decay series constituents were detected in the perched water.

- Thorium-232 decay series constituents were detected in only one (WL-219) of the perched water samples.

- All detected priority pollutant metals from the perched water and the Area 2 seep were below their respective maximum contaminant levels (MCLs).

- Petroleum hydrocarbons were detected in the perched water samples at concentrations between 1.3 and 14 ppm. Petroleum hydrocarbons were detected in the Area 2 seep sample at a concentration of 0.48 ppm.

- Ten halogenated and aromatic VOC compounds were detected in the perched water samples. Three aromatic VOC compounds were detected in the Area 2 seep.

- Thirteen SVOCs were detected in the perched water sample while only two SVOCs were detected in the Area 2 seep samples.

- Eight pesticides were detected in the perched water samples and PCBs were detected in two of the samples. No pesticides or PCBs were detected in the Area 2 seep sample.

- McLaren/Hart stated that both the perched water and the Area 2 seep sample exhibited many of the conditions indicative of landfill leachate including: total dissolved solids concentrations ranging from 2,300 to 6,300 ppm, total suspended solids ranging from 1,500 to 6,000 ppm, chloride concentrations ranging from 510 to 1,500 ppm, chemical oxygen demand ranging from 690 to 1,400 ppm, biological oxygen demand ranging from <300 to 460 ppm and ammonia concentrations ranging from 93 to 220 ppm.

- The thorium-230 data issues for the soil analyses do not exist for the perched water.

4.4.4.5 Geotechnical Testing

The RI/FS Work Plan required the collection of geotechnical data and an evaluation of the landfill slope on the north side of Area 2 because of an historic "slope failure" which was reported to have occurred prior to 1987. Based upon inspection of this area, review of aerial photographs and reports of individuals present at the time, the reported "slope failure" actually was scouring and erosion associated with runoff channels located on the face of the landfill berm. This erosional scour resulted in transport of soil, some of which contained radionuclides, from Area 2 down onto the adjacent property where it meets the Area 2 slope.

As part of the site investigations, four surficial soil samples were obtained from the slope area in the vicinity of weir 5 and tested for moisture content, three of the samples were tested for bulk density and dry density and one of the samples was tested for direct shear strength. These data and the associated evaluations were not presented or described in any of the McLaren/Hart reports. Results of the geotechnical testing are summarized on Table 4-2 and copies of the geotechnical laboratory report were included as Attachment A to the IIR Technical Memorandum (EMSI, 1997b).

Prior to 1987, a road was located along the northern edge of Area 2 along the landfill slope. A February 9, 1987 aerial photograph shows that this road did not prevent overland flow from running down the slope and out onto to the adjacent property near an area previously used for farming (the "farmer's field"). It should be noted that the area at the base of the slope has not been used for farming or any other activity in recent years although farming activities have been conducted to the north of this area. The slope area was also sparsely vegetated during this time period.

The current topographic conditions indicate that the historic configuration of the landfill concentrated the overland flow in a manner that resulted in channeling of overland flow in this area. The sediments in the area of channeling were mobilized because of the higher hydraulic energy associated with channelized flow and transported down the face of the landfill onto the adjacent property. Upon hitting the relatively flat field, the sediment-laden water lost its energy and deposited the materials onto the ground. Erosion of the landfill soils was further compounded by a lack of vegetation in this area at the time of the erosional failure. Vegetative cover typically helps anchor soils in place and reduce or eliminate soil erosion and transport.

As a result of identification of radiologically impacted soils in the vicinity of the slope, additional berms were constructed in 1987 at the top of the slope and along the road to prevent further erosion and transport of Area 2 soils. In addition, the area has subsequently become heavily vegetated. These activities have significantly reduced or eliminated off-site sediment transport. Moreover, the current overland flow possesses far less energy than the channelized flow conditions that previously existed, greatly reducing the potential for erosional scour of the slope surface.

Review of the sediment sample analyses obtained from weirs 5, 6 and 7 indicate that sediments containing radionuclides are being transported at the top and down the landfill slope in the vicinity of weir 5 and to a lesser degree near weirs 6 and 7. Numerous soil borings including McLaren/Hart borings WL-201 through WL-206 and EMSI borings FP-1 through FP-8 have been constructed on the adjacent Ford property, at the based of the landfill slope. Review of the radiological results from the soil samples obtained from these borings indicate that only a small isolated area of radiologically impacted soils is present on the adjacent Ford property. The radionuclide activity levels detected in the surface and subsurface samples obtained from these soil borings indicate that soils with elevated radionuclide levels are only present at the surface of the Ford property and do not extend below the upper 6 to 12 inches of soil materials. These data indicate that the materials transported after the construction of the berm and the natural revegetation processes, if any, are limited to overland flow along the landfill slope. Any sediment that may have been transported off of the landfill as part of this overland flow have been deposited in a small area at the toe of the landfill slope.

Finally, significant rainfall and associated stormwater runoff occurred in the St. Louis area in 1993 and in May 1995. According to the U.S. Geological Survey (Parrett, et al., 1993), from mid-June through early August 1993, flooding was severe in the upper Mississippi River Basin following a wet-weather pattern that persisted over the area for at least 6 months prior to the flood. Peak discharge for the Missouri River in the area of the West Lake Landfill exceeded the 100-year recurrence interval. The U.S. Army Corps of Engineers uses the 1993 record flood for comparison to other flood events.

According to McLaren/Hart (1996e), the May 1995 storm was equivalent to a 100-year event for a two-day duration. The USCOE has indicated that 6-10 inches of rain were common with isolated instances of 12 –13 inches reported for May 17-18, 1995. A total of 12.93 inches of rainfall occurred in May 1995 resulting in this being the wettest May on record (325% of normal)) for the St. Louis area. May 1995 also was the second wettest month ever for the St. Louis area behind August 1946. The St. Charles gage on the Missouri River recorded a crest elevation equivalent to a flood event with a 40-year recurrence interval.

These storm events reportedly did not result in identifiable erosional scour of the landfill slope. This further supports the conclusion that the presence of the berms at the top of the slope and the resultant diversion of the majority of runoff from this area along with the extensive vegetative cover that has become established along the landfill slope have acted to greatly reduce or eliminate the potential for erosional scour of the landfill slope area.

Based on an inspection of the area and review of the aerial photographs and other available information, EMSI concludes that the historical "slope failure" was not a classical circular or deep seated slope failure but was limited to erosional scour and transport of surficial soils on the top and along the landfill slope in a small area immediately above the location of soil boring WL-206. This conclusion is further substantiated by the fact that the refuse materials logged in boring WL-208 consisted of concrete and other demolition debris materials that are resistant to circular slope failure because of their interlocking nature.

The erosional scour of the landfill slope occurred when the surficial soils were readily exposed prior to 1) the growth of significant vegetation cover; and 2) the construction of runoff control berms in this area. Subsequent to the slope failure significant shrubs, small trees and other vegetation have become established along the slope in the area of the historical scour and transport of the surficial soils. In addition, substantial berm construction has been performed at the top of the slope to divert water away from this area. The successful diversion of water is documented by the fact that

McLaren/Hart had difficulty obtaining runoff samples from weirs 5 and 7, located in this area, and ultimately never documented any flow in weir 6. It should be noted that although the berms are effective in diverting runoff during typical storm events, they apparently were not effective in diverting runoff during extreme storm events as evidenced by the washout of the weirs in this area during the May 1995 storm event. The presence of the extensive vegetation along the landfill slope also serves to demonstrate that significant erosion of this area is no longer occurring. Furthermore, the presence of this vegetative cover along with the berms at the top of the slope will act to further reduce or eliminate the potential for erosional scour and surficial transport of soils from this area.

As previously indicated, based upon discussions with EPA, it was decided that the Respondents would regrade this slope to a lower overall slope angle, either by excavation or through placement of additional fill materials, as part of any remedy that may be selected for OU-1. Regrading of this slope to a lower angle obviated the need for additional investigative and testing activities. This approach was accepted and agreed to by EPA.

4.4.5 Data Quality

During its initial review of the radiological data, McLaren/Hart noted apparent inconsistencies in the thorium-230 results. It appeared that some of the reported occurrences of the higher levels of thorium-230 were not consistent with other laboratory results and site data. In addition, the results of some of the samples collected from background locations were also anomalously high.

Based on these apparent discrepancies in the thorium-230 results, McLaren/Hart initially had the laboratory (Quanterra) re-analyze some of the samples. As a result, about 20 percent of the samples were re-analyzed, and the results of these analyses indicated substantially lower thorium-230 levels. The analytical laboratory identified two possible factors contributing to the erroneously high results. One source of this problem was poor laboratory spiked tracer recovery due to tailing of the tracer (thorium-229) into the thorium-230 region of the analytical curve. This "tailing effect" resulted in higher reported values for thorium-230. A second source of the higher reported thorium-230 levels was analytical interference with the uranium-234 in the samples. Both of these effects were identified by the laboratory and are discussed further in McLaren/Hart's Soil Boring/Surface Soil Investigation Report (McLaren/Hart, 1996h) and the laboratory correspondence contained in the appendices to McLaren/Hart's report.

Quanterra revised their protocols to eliminate interference from these two sources. The surface samples with initial analytical results greater than 5 pCi/g and the subsurface samples with initial analytical results greater than 15 pCi/g were then re-analyzed for thorium-230 using the revised protocols. The resulting re-analyzed values were determined by the laboratory and McLaren/Hart to be the valid and representative analyses. A summary of the various re-analysis events and the specific samples that were subjected to re-analysis is contained in the appendix to McLaren/Hart's "Soil Boring/Surface Soil Investigation Report" (McLaren/Hart, 1996h). The re-analyzed values were used in the subsequent data presentations and interpretations.

Although McLaren/Hart and the laboratory did identify and ultimately resolve the thorium-230 data quality issue, an outstanding data quality issue still remains. Specifically, although the majority of the samples with reportedly high levels of thorium-230 were ultimately re-analyzed, samples with lesser, but still reported levels of thorium-230 were not re-analyzed. Selection of samples for re-analysis was based on the initially reported results. Therefore, surface samples with thorium-230 activity levels below 5 picocuries per gram (pCi/g) and subsurface samples with levels below 15 pCi/g were not re-analyzed. Therefore, the thorium-230 results for these samples may be biased high.

As previously indicated, McLaren/Hart provided split soil samples to Accu-Labs Research at the request of EPA. The results of the split-sample analyses are included in McLaren/Hart's Split Soil and Groundwater Sampling Data Summary Report - West Lake Landfill Areas 1 & 2 (McLaren/Hart, 1996f). McLaren/Hart concluded that the results of the split sample analyses confirmed the validity of the radiological results in general. McLaren/Hart further concluded that the results of the split sample analyses also supported their conclusion that the initial Quanterra results were affected by the analytical problems described above, initially resulting in artificially high thorium-230 results

Based upon the results of the various laboratory evaluations, the results of the data validation and data evaluation performed by McLaren/Hart, and the results of the re-analyses of the soil samples, McLaren/Hart and the laboratory (Quanterra) concluded that the initial throium-230 results were erroneous and biased high. Based upon our review, EMSI concurs with their conclusions. As a result, similar to the approach taken by McLaren/Hart in the Soil Boring/Surface Soil Investigation Report (McLaren/Hart, 1996h), only the re-analyzed sample results are presented and evaluated in the RI.

Review of the thorium-230 obtained from the sample re-analyses indicates that samples with elevated thorium-230 levels generally corresponded with occurrences of elevated levels for other radionuclides. Consequently, EMSI considers the thorium-230 results to generally be representative and reliable, with the caveat that as indicated above, soil samples with initial results less than the reference levels were not subjected to re-analysis and therefore may be biased high.

Although we have considered all of the reportedly valid thorium-230 results in the RI, it should be noted that there are some reported occurrences of elevated thorium-230 which are inconsistent with other measures of radionuclide activity obtained as part of the RI effort. For example, several instances of reportedly elevated thorium-230 occurrences were detected by the laboratory analyses in locations where elevated overland gamma results, elevated downhole gamma results, or elevated levels of other radionuclides were not detected. Generally, the thorium-230 levels associated with these inconsistencies are only slightly above the reference levels. As a result, the representativeness of these few thorium-230 results may be suspect; however, as thorium-230 is not a strong gamma emitter, none of the results of the laboratory analyses have been ignored or otherwise discounted based on this inconsistency. These occurrences are discussed further in Section 6 of this report as they relate to the nature and extent of the radiologically impacted materials at the landfill.

4.4.6 Outstanding Issues or Items

McLaren/Hart did not identify any outstanding issues or items associated with the soil investigation other than the thorium-230 data quality issue discussed above. As indicated, a data quality issue potentially exists with the thorium-230 results below 5 pCi/g (surface soils) and 15 pCi/g (subsurface soils) as samples with results below these levels were not subjected to re-analysis. Results below these levels may be biased high. The potential impacts of this data quality issue, if any, will be considered during the evaluation of the radiologically impacted materials discussed in Section 6 of this report.

Based on EMSI's evaluation of the soil investigation results, it was clear that all of the information necessary to perform a slope stability analysis for the landfill berm in Area 2 had not been obtained. As was discussed previously in Section 4.4.4.5 sufficient information was available to assess the nature of the previous loss of radiologically impacted materials from Area 2 down the landfill berm and to assess the potential for future losses. Furthermore, as previously indicated, the OU-1 Respondents have agreed to regrade the landfill berm slope as part of any remedy that may be selected for OU-1 thereby obviating the need for additional data. This approach was agreed to and accepted by EPA. Therefore, the additional information necessary to assess the stability of the landfill berm is no longer required.

4.5 Groundwater Investigation

Groundwater characterization activities were completed to assess the distribution and flow of groundwater beneath Areas 1 and 2 as well as to determine the magnitude and extent, if any, of radiological activity in the groundwater.

4.5.1 Purpose and Scope of Investigation

Details regarding the scope, procedures and results of the groundwater investigation are presented in McLaren/Hart's Groundwater Conditions Report - West Lake Landfill Areas 1 & 2 (McLaren/Hart, 1996g) and SCSR (EMSI, 1997c). The scope of the groundwater investigation completed or supervised by McLaren/Hart included:

- Collection of samples from thirty existing wells for gross alpha measurement to evaluate water disposal options;

- Installation of 14 new groundwater monitoring wells;

- Development of the 44 new and existing wells;

- Routine measurement of groundwater levels in all wells;

- Collection of five sets of groundwater samples from varying sets of wells by McLaren/Hart and one set of samples by EMSI (see discussion below);

- Analysis of groundwater samples and split samples; and

- Slug testing of 18 wells to measure hydraulic conductivity.

4.5.2 Summary of Methods and Procedures Used

The procedures used to complete this activity were detailed in Section 6.4 of the approved RI/FS Work Plan. A summary of the work completed using each of these protocols is presented below.

4.5.2.1 Monitoring Well Installation

McLaren/Hart installed 14 groundwater monitoring wells including four wells in Area 1, four wells in Area 2 and six wells on the Ford property farmer's field. Borings advanced through landfill refuse were first pre-drilled, radiologically logged and back-filled using the protocols presented in the RI/FS Work Plan. It should be noted, however, that flowing sands prevented the collection of some of the samples for inspection and lithologic descriptions as prescribed by the RI/FS Work Plan. Details on well locations and depths are presented in the Groundwater Conditions Report (McLaren/Hart, 1996g).

Eighteen new monitoring wells were originally proposed in the RI/FS Work Plan. The Work Plan anticipated installation of seven shallow wells (three in Area 1 and four in Area 2), six intermediate wells (two in Area 1 and four in Area 2) and five deep wells (two in Area 1 and three in Area 2). The four proposed wells that were not installed included:

- The shallow and intermediate wells proposed as part of a well cluster along with well D-14 in Area 1 were not drilled because groundwater was not encountered during the drilling of soil boring WL-109 at this location. Well D-14, the deep well in the cluster was installed as proposed.

- The shallow well proposed for the eastern edge of Area 1 was not drilled because a new well (PZ-114-AS) had recently been installed at this location by Golder Associates as part of the OU-2 investigation and was available for sampling as part of the OU-1 groundwater investigation. As a result, well PZ-114-AS was used in place of installation of a new well at this location.

- The shallow well to be drilled in conjunction with well D-13 at the eastern corner of Area 2 was also not drilled as a shallow well because MW-F3 already existed in this area and was available for sampling as part of the OU-1 groundwater investigation. As a result, well MW-F-3 was used in place of installation of a new well at this location.

4.5.2.2 *Monitoring Well Development*

The 14 new wells and 30 non-damaged existing wells were developed by removing a minimum of 10 well volumes of groundwater. During well development, McLaren/Hart also monitored pH, electrical conductivity, and temperature. Well development continued until consecutive readings were within 10 percent of each other and the produced water was non-turbid. All development water was containerized and analyzed per St. Louis Metropolitan Sewer District (MSD) disposal criteria. The water was then discharged into the MSD system upon receipt of results and with MSD approval.

4.5.2.3 Groundwater Level Measurement

McLaren/Hart measured groundwater levels from all existing monitoring wells on a monthly basis from November 1994 to November 1995 and from the newly-constructed wells from their development date to November 1995. Groundwater level measurements were subsequently collected on a quarterly basis from all wells through October 1996. McLaren/Hart followed the protocols presented in the approved RI/FS Work Plan during each measurement episode. Wells from which groundwater level data were obtained are shown on Figure 4-11. Results of the water level measurement activities are summarized on Tables 4-3 ad 4-4.

4.5.2.4 Well Slug Testing

McLaren/Hart completed slug testing on twelve of the new wells and six of the existing wells using the protocols presented in the approved RI/FS Work Plan. The resulting data was analyzed using the AQTESOLV™ software (Geraghty & Miller, 1989).

4.5.2.5 Groundwater Sample Collection

McLaren/Hart completed five different groundwater-sampling episodes. In addition, supplemental groundwater sampling was performed under EMSI's supervision. Groundwater sampling locations are shown on Figure 4-12. The first episode consisted of collecting grab samples from the 30 existing wells prior to their development to obtain approval for disposal of the development and purge water. Each sample was analyzed for gross alpha. Three wells were re-sampled, filtered, and re-analyzed following initial gross alpha results above the MSD standard. All three re-analyzed results were below the MSD standards. Further information on this task is presented in the Groundwater Conditions Report.

The second (November 1995) and third (February 1996) episodes of groundwater sampling conducted by McLaren/Hart included sampling of the 14 new wells and 16 of the existing wells. McLaren/Hart completed a fourth sampling round in May 1996 to resolve issues related to thorium-230 (potential false positives) and radium-226 (analytical results above MCLs). All three sampling episodes were completed using the protocols specified in the approved RI/FS Work Plan.

The RI/FS Work Plan called for sampling all of the newly constructed RI monitoring wells as well as 14 of the existing monitoring wells. The 14 existing monitoring wells to be sampled included five shallow wells (S-60, S-61, S-84, MW-101, and MW-106), five intermediate wells (I-62, I-65, I-66, I-67, and I-68), and four deep wells (D-83, D-85, D-93, and D-94).

A total of 30 monitoring wells were sampled in each of the second, third and fourth episodes discussed above to comply with the RI/FS Work Plan Requirements. The set sampled included 14 newly constructed RI monitoring wells, two shallow wells (MW-F3 and PZ-114-AS) that were part of the landfill monitoring program and that were substituted for two of the planned new wells, and 14 existing monitoring wells, two of which serve as background monitoring wells. The wells sampled are summarized on Table 4-5 and construction information for these wells is summarized on Table 4-6. Additional information regarding the construction of these and other wells at the landfill can be found in the "Groundwater Conditions Report, West Lake Landfill Areas 1 & 2" (McLaren/Hart, 1996g) and in the "RI/FS Work Plan for the West Lake Landfill Site, Bridgeton, Missouri" (McLaren/Hart, 1994a).

Of the 14 existing wells proposed for sampling in the RI/FS Work Plan, three were replaced by other wells. These included wells S-60, D-94, and MW-106. As reported in the Site Reconnaissance Report (McLaren/Hart, 1996b), well S-60 could not be located. As a result, one of the proposed RI wells, S-1, was relocated to the vicinity of S-60. Well D-94 was reportedly damaged and the casing was obstructed. As a result, this well was not sampled. As reported in the Site Reconnaissance Report

(McLaren/Hart, 1996b), high turbidity levels were encountered prior to and after re-development of background well MW-106. As a result, background well MW-107 was substituted for MW-106. An additional existing background well, S-80, was also added to the list of wells to be sampled. In addition, existing well S-82 was added to the list of existing wells sampled as this well along with existing well D-93 and new well I-9 were used as the monitoring well cluster originally proposed for the southwestern corner of Area 2.

Two background wells, S-80 and MW-107, were included in the groundwater sampling episodes. These wells are considered background because they are horizontally located 3,800 and 4,400 feet respectively from the closest boundary of either Area 1 or Area 2. In addition, these wells are considered to be up-gradient of the landfill because their water level elevations are generally 3 and 13 feet higher respectively than the groundwater elevations beneath Areas 1 and 2.

Additional groundwater samples were collected during May, 1997 according to the procedures presented in the EPA approved ASAP. The additional data was collected to compare the site radiological levels in groundwater to the State of Missouri Maximum Contaminant Levels (MCLs) and to resolve issues associated with potential data quality problems related to the thorium isotope results. Additional filtered and unfiltered samples were collected from seven groundwater monitoring wells (S-82, I-2, I-4, D-3, D-6, D-12, D-93) and analyzed for gross alpha and the approved radionuclide suite. A sample could not be collected from well D-14 because of an obstruction in the casing. A duplicate sample from well S-82 was also submitted for quality assurance evaluation.

4.5.3 Deviations from Work Plan

The following deviations from the procedures prescribed in the EPA approved RI/FS Work Plan were noted:

- McLaren/Hart was unable to obtain all of lithologic samples anticipated by the Work Plan due to flowing sands encountered during well drilling.

- Some minor deviations in the proposed well completion program were required due to occurrences of the groundwater table near the base of the landfill and the presence of flowing sands in the alluvium. Specifically, in well S-5, the height of the filter pack above the top of the screen was decreased to reduce the potential for leachate migration along the well bore. In addition, mud rotary drilling procedures using "revert" biodegradable drilling additives were employed in conjunction with the hollow stem auger drilling in monitoring wells I-11, D-12 and D-13 in Area 2 to counteract caving of the unconsolidated alluvium.

- McLaren/Hart did not complete slug tests on all newly installed wells as prescribed by the Work Plan, but rather completed testing on 12 new wells and six existing wells. This change was made to increase the areal and vertical coverage of the resultant hydraulic conductivity data.

These deviations either improved or had no effect on the quality of the data obtained by the groundwater investigation or the ability of the investigation to achieve the data quality objectives for this work. There was only one deviation noted by EMSI from the EPA approved ASAP; that is a groundwater sample was not collected from well D-14 because the casing was obstructed.

4.5.4 Summary of Results

Results of the analyses of the various groundwater samples obtained during the RI are contained in Appendix C. A summary of the principal observations made by McLaren/Hart based upon the groundwater data they collected include:

- Constituents in the uranium-238, uranium-235 and thorium-232 decay series were detected in both of the up-gradient background wells (S-80 and MW-107).

- Six of the priority pollutant trace metals (arsenic, chromium, copper, lead, nickel and zinc) were also detected in unfiltered samples from the background wells. Trace metals were not detected in the filtered samples.

- Constituents in the uranium-238, uranium-235 and thorium-232 decay series were measured near background levels in wells at the landfill. Constituent levels were generally below 3 picocuries per liter (pCi/l) in the wells at the landfill. There were minimal differences between the results obtained from the filtered and unfiltered samples.

- Eight of the priority pollutant trace metals (arsenic, chromium, copper, lead, mercury, nickel, selenium, and zinc) were detected in the unfiltered samples from wells at the landfill. With the exception of the single detection of mercury in well D-14 (0.21 μg/l) and a single detection of selenium in well MW-101 (38 μg/l), all of these trace metals were also detected in the background well samples. For the six trace metals detected in both background and site wells, the levels of the trace metals detected in the unfiltered samples from the wells at the landfill were similar to or less than the levels of the trace metals found in the background wells. The two exceptions were the arsenic results in six of the site wells and the nickel levels in well S-5 (arsenic 13 to 420 μg/l verses background of <0.1 to 20 μg/l; nickel 93 to 110 μg/l verses background of <0.2 to 74 μg/l). Furthermore, with the exception of arsenic and to a lesser extent nickel, the trace metals generally were not detected in the filtered samples.

- Total petroleum hydrocarbons were detected in six wells at concentrations from 0.53 to 3.5 ppm.

- Eleven VOCs including benzene, several chlorobenzene compounds and acetone (a known laboratory contaminant) were detected in the wells at the landfill. These compounds were not detected in the background wells.

- Four SVOCs (1,4 dichlorobenzene, 4-methyl phenol and two phthalate compounds (known laboratory contaminants) were detected in wells at the landfill. These compounds were not detected in the background wells.

- Three pesticides were detected in wells at the landfill in the November 1995 sampling episode. They were not detected during the February 1996 episode. No PCBs were detected during either sampling event.

- The hydraulic conductivity of the shallow materials (average of 8×10^{-3} centimeters per second [cm/sec]) is slightly less than average hydraulic conductivity results obtained from the intermediate and deep monitoring wells (4×10^{-2} cm/sec).

4.5.5 Data Quality Issues

In January 1996, Quanterra identified a data quality issue relative to the thorium-230 analytical results obtained from the November 1995 groundwater-sampling activity. Specifically, the thorium-230 results from the November 1995 samples appear to contain false positives or to have been reported at levels higher than actually present. This problem was a result of the volume reduction portion of the sample preparation and analysis procedure and was identified by Quanterra based on poor analytical recoveries of the laboratory-spiked tracer (thorium-229). Many of the analytical results for the November 1995 samples displayed either no tracer recovery or had tracer recoveries below Quanterra's internal acceptance criteria of 20%. As a result of the poor tracer recovery, a greater instrument response factor was used in the calculation of the sample activity levels resulting in artificially high reported sample results. As a result of Quanterra's identification of the problem, Quanterra implemented a corrective action procedure with respect to samples collected during the February 1996 sampling method consisting of a change from the precipitation method to an evaporative technique during sample preparation. In addition, a third round of groundwater sampling and thorium-230 analyses was implemented in May of 1996 using the revised sample preparation protocol.

Review of the thorium-230 data shows that the November 1995 unfiltered samples exceeded the February and May 1996 values for 15 of 18 wells where thorium-230 was detected. The November 1995 filtered samples also exceeded the February and May 1996 values in 12 of the 14 wells where thorium-230 was detected. Therefore, the

November 1995 groundwater analytical results for thorium-230 appear to be biased high. This bias needs to be considered in any potential use of this data.

A data quality issue was also identified with respect to the radium analyses. Specifically, the protocol in the RI/FS Work Plan required an analytical method (EPA Method 903.0) with a minimum detectable activity level below the MCL values; however, this analytical method was not specified on the chain of custody forms for both the November 1995 and February 1996 sampling events. As a result, only gamma spectroscopy results were obtained for these groundwater samples. The minimum activity levels detectable by gamma spectroscopy analyses exceed the MCL for radium-226 and radium-228. As result, the unfiltered samples obtained in February 1996 were analyzed for radium-226 using the EPA method with the lower minimum detectable activity level. In addition, as directed by EPA, all of the wells were re-sampled for radium isotopes in conjunction with the re-sampling for thorium-230 performed in May of 1996. These samples were analyzed for radium-226 using the EPA method with the lower minimum detectable activity level.

Neither McLaren/Hart nor EMSI identified any other data quality issues.

4.5.6 Outstanding Issues or Items

Neither McLaren/Hart nor EMSI identified any outstanding issues.

4.6 Surface Water and Sediment Investigation

McLaren/Hart performed investigations of rainwater runoff, erosional sediment chemistry, and surface water quality to provide data on potential surface-water transport pathways for the health based risk assessment. The methodologies used, scope of activities and the results of these investigations are described in McLaren/Hart's Rainwater Runoff, Erosional Sediment, Surface Water, and Leachate Sampling Data Report - West Lake Landfill Areas 1 & 2 (McLaren/Hart, 1996e).

Supplemental rainwater runoff, surface water, and sediment investigation activities were conducted by EMSI. The results of these activities were presented in the SCSR (EMSI, 1997c) and this RI.

Locations of the various weirs used to obtain rainwater/runoff and erosional sediment samples at the landfill are shown on Figure 4-13. This figure also shows the locations of from which off-site sediment samples were obtained. Also shown on this figure are the various locations from which surface water level measurements were obtained as well as the locations of the off-site surface water quality samples.

4.6.1 Purpose and Scope of Investigation

McLaren/Hart performed surface water and sediment sampling to provide the data necessary to evaluate the surface water - groundwater interactions and to assess the potential for chemical transport via surface water and sediments. This investigation included obtaining water level measurements from the various surface water bodies in the area and measurement of rainwater runoff flows from Areas 1 and 2 (Figure 4-13). This investigation also included sampling and chemical analyses of rainwater runoff and erosional sediments from nine weir locations at the margins of Areas 1 and 2 along with sampling and chemical analyses at two surface water locations in the vicinity of the landfill. In addition, samples and chemical analyses were performed on the leachate from the seep located near the western boundary of Area 2.

EMSI preformed additional surface water and sediment sampling in May, 1997 to provide concentration data for gross alpha, radium-226 and radium-228 using an analytical method with detection limits below relevant MCLs and to further evaluate the thorium-232/radium-228 and thorium-230/radium-226 relationships. Surface water samples were collected near the southern edge of the North Surface Water Impoundment and from the Flood Control Channel at McLaren/Hart staff gage location 6 / 7. These locations were selected because they are the approximate locations where all runoff contributions from the landfill have reached the perimeter surface water drainage system (McLaren/Hart, 1996d).

Sediment samples were collected by EMSI at the following locations:

- Sample location SED-1 located at the intersection of the landfill property boundary and the east-west drainage ditch along the south side of the access road. This location is where sediment mobilized from Area 1 would exit the property;

- Sample location SED-2 located at the intersection of the property boundary and the northern access road perimeter ditch;

- Sample location SED-3 located from the perimeter ditch along the west side of St. Charles Rock Road halfway between the SED-2 sampling location and the North Surface Water impoundment, and;

- Sample location SED-4 located immediately above the intersection of the perimeter ditch on the west side of St. Charles Rock Road with the North Surface Water Impoundment.

Sediment samples were also collected by EMSI from behind six of the ten weirs (WEIRS-3, 4, 5, 8, 9, and 10) according to the amended ASAP to verify the results reported in the Rainwater Runoff, Erosional Sediment, Surface Water, and Leachate Sampling Data Report (McLaren/Hart, 1996d). The sampling included Weir-10 that was installed in May 1997 to provide supplementary data for the areas drained by Weir-8 and Weir-9.

4.6.2 Summary of Methods and Procedures Used

The following subsections present a summary of the methods and procedures used by McLaren/Hart and EMSI during the various investigations of rainwater runoff, erosional sediment, surface water and leachate. Information and additional details regarding the rainwater runoff, sediment and surface water sampling are included in the Rainwater Runoff, Erosional Sediment, Surface Water, and Leachate Sampling Data Report (McLaren/Hart, 1996e), the ASAP (EMSI, 1997a), and the SCSR (EMSI, 1997c). Additional information regarding these activities is included in McLaren/Hart's letters of March 30, 1995 and June 22, 1995 (McLaren/Hart, 1995c), EMSI's letter of April 29, 1997 (EMSI, 1997e) and EPA's letter of May 5, 1995 (EPA, 1995a).

4.6.2.1 Rainwater Runoff Sampling

Field reconnaissance of topographic conditions and the presence of erosional channels during October 1994 to March 1995 were used to identify nine locations (four in Area 1 and five in Area 2) where rainwater potentially ran-off of Areas 1 and 2. To estimate the amount of rainwater runoff flow from Areas 1 and 2, McLaren/Hart installed a series of calibrated "V-notch" weirs at each of the nine locations. At each of the sampling locations, runoff was directed through the "V-notch" weir. The weirs were installed in April 1995 and surveyed for location and elevation control.

Per the EPA approved RI/FS Work Plan, rainwater runoff samples were to be collected within 24 hours of a rainwater event that produced a sufficient quantity of runoff for collection of samples. Specifically, rainwater runoff samples were to be collected after a storm that was forecast to produce at least 1-inch of rain at nearby Lambert Field (the St. Louis International Airport).

Samples were collected from the four Area 1 weirs on May 18 and 19, 1995; however, sampling of the Area 2 weirs could not occur at this time as planned. The severity of the storm associated with this rainfall event (9.54 inches on May 16 and 17, 1995 equivalent to a 100-year storm event for a 2-day duration) caused erosional scour and undermining of the weirs placed near the western slope of Areas 2 (above the Ford property farmer's field). In addition, on the east side of Area 2, water from adjacent landfill operations (roll-off box storage area and the construction debris landfill) flows toward and commingles with the runoff from Area 2. At the time of the May 1995 storm, the weirs on the eastern portion of Area 2 were not located in a manner to isolate and sample Area 2 runoff only.

During the remainder of 1995 and the first quarter of 1996, no storms producing sufficient runoff for sampling the Area 2 weirs occurred. As required by the RI/FS Work Plan, McLaren/Hart performed site reconnaissance throughout this period during and after each storm which produced at least one-inch of rainwater at the St. Louis Lambert Field International Airport or which had the potential to produce sufficient runoff for sampling. Based on daily precipitation records, there were only two events that produced over one inch of rain at Lambert Field during the period from May through December of 1995. Reconnaissance of the weirs during both of these events indicated that runoff was not occurring.

Area 2 rainwater-runoff samples were finally collected on April 29, 1996. At the time the sampling was performed, no runoff was occurring at Weir 6, one of the three weirs located along the western portion of Area 2. As a result, no runoff sample could be collected from this location. On the east side of Area 2, water had ponded around the two weir locations (Weirs 8 and 9), however, no runoff was occurring. As a result, samples of the ponded water were collected.

Rainfall runoff samples were also collected from the weirs 3, 4, 5, 8, 9, and 10 on August 19, 1997 as part of the ASAP field activities to verify the results reported in the *Rainwater Runoff, Erosional Sediment, Surface Water, and Leachate Sampling Data Report* (McLaren/Hart, 1996d). This sampling activity included Weir-10 that was installed in May 1997 to provide supplementary data for the areas drained by Weir-8 and Weir-9. Specifically, weir 10 was installed down-slope of weirs 8 and 9 in an attempt to obtain flowing rather than ponded runoff from this portion of Area 2. It should be noted however, that the location in which weir 10 was installed does potentially receive some minor component of runoff from a limited portion of the landfill south of Area 2.

4.6.2.2 Erosional Sediment Sampling

Concurrent with the rainwater runoff sampling, erosional sediment samples were collected from sediment that had accumulated behind the "V-notch" weirs. As required by the RI/FS Work Plan, erosional sediment samples were collected after rainwater runoff had abated. Sample collection and handling were performed consistent with the procedures outlined in the Sampling and Analysis Plan. Additional information is presented in the Rainwater Runoff, Erosional Sediment, Surface Water and Leachate Sampling Data Report (McLaren/Hart, 1996e) and SCSR (EMSI, 1997c). Results of the radiological and non-radiological analyses of the erosional sediment samples are presented in Appendix E.

4.6.2.3 Surface Water and Leachate Sampling

Surface water samples were collected from the surface water body north of Area 2 and from the flood control channel along the west side of the property in accordance with the procedures outlined in the RI/FS Work Plan. Complete details regarding the initial surface water sampling are presented in the Rainwater Runoff, Erosional Sediment, Surface Water and Leachate Sampling Data Report. In accordance with the ASAP, supplemental surface water samples were collected by EMSI in May 1997, as discussed in the SCSR (EMSI, 1997c).

McLaren/Hart collected a leachate sample from a seep located on the western landfill slope near the southwest corner of Area 2 as required in the RI/FS Work Plan. No other leachate seeps were identified. Details of the leachate seep sampling are presented in the Rainwater Runoff, Erosional Sediment, Surface Water and Leachate Sampling Data Report.

As discussed above, water samples were collected from the North Surface Water Body and the Flood Control Channel by EMSI on May 15, 1997 as part of the ASAP field activities. The purpose of these additional samples was to provide confirmation of the results previously obtained by McLaren/Hart. The samples were collected according to the protocols outlined in the EPA approved ASAP.

4.6.3 Deviations from Work Plan

Deviations from the RI/FS Work Plan noted by McLaren/Hart included the following:

- The erosional sediment and rainwater runoff samples were collected from Areas 1 and 2 after differing precipitation events because samples could not be collected from Area 2 at the time Area 1 runoff samples were collected;
- The rainwater runoff samples from behind Weirs 8 and 9 were collected from ponded water rather than flowing water as anticipated by the RI/FS Work Plan because flowing water was not present at these locations; and
- A sample could not be collected from Weir 6 in Area 2 because no flow or ponded water was present.

The only deviation from the approved ASAP was that rainwater runoff and sediment samples were not collected from Weirs 1, 2, 6, and 7 because rainfall during the field program interval was insufficient to produce runoff at these locations.

4.6.4 Summary of Results

Results of the surface water and sediment sample analyses are presented in Appendices D and E. Based upon the data collected, preliminary conclusions were developed by McLaren/Hart and presented in their Rainwater Runoff, Erosional

Sediment, Surface Water and Leachate Sampling Data Report (McLaren/Hart, 1996e). A summary of the primary observations made by McLaren/Hart included the following:

- Uranium-238, uranium-235 and thorium-232 decay series constituents were present in both the rainwater runoff and sediments in Area 1;
- Non-radiological compounds of concern that were present in the rainwater runoff from Area 1 included VOCs and SVOCs;
- Non-radiological compounds of concern that were present in the erosional sediments from Area 1 included metals, SVOCs, TPH (as motor oil), and pesticides;
- Uranium-238, uranium-235 and thorium-232 decay series constituents were present in both the rainwater runoff and sediments in Area 2;
- Non-radiological compounds of concern were not present in the rainwater runoff from Area 2;
- Non-radiological compounds of concern that were present in the erosional sediments from Area 2 included metals, SVOCs, TPH (as motor oil), and pesticides;
- Only one leachate seep was identified, and McLaren/Hart noted that it only flowed after significant rainfall events or periods of extended rainfall;
- Constituents from the uranium-238 decay series were present in the leachate seep sample; and
- Non-radiological compounds of concern that were present in the leachate seep sample included, VOCs, SVOCs, metals, TPH (as diesel and motor oil), and pesticides.

The results from the surface water and sediment sampling efforts conducted during the ASAP were generally similar to the results obtained by McLaren/Hart. None of the surface water samples contained radionuclide levels above their respective MCLs. Sediment samples obtained from weir 2 in Area 1 and weirs 5, 6, 7 and 9 in Area 2 (Figure 4-13) contained radionuclides, (principally but not exclusively thorium-230, radium-226, and lead-210) at levels greater than the surface soil reference levels (Tables E-1, E-2 and E-3 in Appendix E). Although the original RI sediment samples obtained from Weir 3 did not contain radionuclides above reference levels, the subsequent sample obtained in May 1997 as part of the ASAP testing did contain thorium-230 at 11.6 pCi/g compared to a reference level of 7.54 for this isotope. In addition to the above locations, samples from weir 1 in Area 1 contained throium-230 and radium-226 at levels greater than background but less than the reference levels. Both samples obtained from weir 8 in Area 2 contained thorium-230 at levels greater than background but less than the reference levels. None of the samples obtained from weir 4 located along the north side of Area 1 immediately south of the landfill office building contained radionuclides above background levels.

Of the four sediment samples obtained from the internal and perimeter drainage ditches, only the sample obtained at the easternmost end of the internal drainage ditch along the north side of Area 1 (location SED 1) contained any radionuclides above surface reference levels. This sample contained uranium-234 at 16.3 pCi/g compared to a surface reference level of 7.73 pCi/g. However, analysis of a field duplicate of this sample displayed only 1.04 pCi/g and analysis of a laboratory duplicate of the field duplicate sample contained only 0.95 pCi/g; therefore, the reproducibility of this exceedance is questionable. Similarly, the laboratory duplicate sample contained 6.74 pCi/g of radium-226, which slightly exceeds the surface reference level of 6.3 pCi/g; however, radium-226 was not detected in the original sample at a minimum detectable activity level of 5.08 pCi/g. Therefore, the validity of this potential exceedance is also questionable. None of the other three sediment samples (From SED 2, SED 3 and SED 4 locations) contained any radionuclides above reference levels; however, the minimum detectable activity levels achieved by the laboratory for some of the radionuclides did in some cases exceed the surface reference levels. Most notably, the lead 210 result for samples SED 1 (but not SED 1 duplicate) and SED 3 greatly exceeded the reference level while the radium-223 result for SED 1 (but not SED 1 duplicate) and SED 3 slightly exceeded the reference level. In addition, the bismuth 212 results for locations SED 1, SED 1 duplicate and SED 3 also slightly exceed the reference level. Although thorium-230 was not detected above its reference level in any of the internal or perimeter drainage ditches, samples obtained from SED-1, SED-3 and SED-4 all contained thorium-230 above its background level. The sample from SED-4 also contains radium-226 above the background level. The sample from the SED-2 location did not contain any radionulcides at levels above reference or background levels.

4.6.5 Data Quality Issues

As previously described as part of the discussion of the groundwater investigation, the required analytical technique for radium isotope analyses in water samples was not specified on the chain-of-custody forms. The error was identified by McLaren/Hart in May 1996 and brought to the attention of the EPA Project Manager. At the direction of EPA, all of the monitoring wells were re-sampled for radium-226 and radium-228 as part of the groundwater investigation. However, no re-sampling was required or performed for the surface water and rainwater investigation. Consequently, the minimum detectable activity levels for the rainwater runoff and surface water samples collected by McLaren/Hart exceeded the MCL for radium-226 and radium-228. Therefore, additional surface water samples were collected by EMSI in May 1997 for radium analyses. These results were presented in the Site Characterization Summary Report (EMSI, 1997c) and are described further in Section 7 of this report.

As was discussed above, the sediment sample obtained at the eastern end of the internal drainage ditch located along the north side of Area 1 on the south side of the site access road contained uranium-234 at 16.3 pCi/g compared to a surface reference level of 7.73 pCi/g. The duplicate sample analysis of this sample, however, contained only 0.95 pCi/g; therefore, the reproducibility of this exceedance is questionable. Similarly, the duplicate sample contained 6.74 pCi/g of radium-226, which slightly exceeds the surface reference level of 6.3 pCi/g; however, radium-226 was not detected in the original sample at a minimum detectable activity level of 5.08 pCi/g. Therefore, the validity of this potential exceedance is also questionable. None of the other three sediment samples (From SED 2, SED 3 and SED 4 locations) contained any radionuclides above reference levels; however, the minimum detectable activity levels achieved by the laboratory for some of the radionuclides did in some cases exceed the surface reference levels. Most notably, the lead 210 result for samples SED 1 (but not SED 1 duplicate) and SED 3 greatly exceeded the reference level while the radium-223 result for SED 1 (but not SED 1 duplicate) and SED 3 slightly exceeded the reference level. In addition, the bismuth 212 results for locations SED 1, SED 1 duplicate and SED 3 also slightly exceed the reference level.

4.6.6 Outstanding Issues or Items

The only outstanding issue is the high radium isotope minimum detectable activity level in the surface water and rainwater runoff samples as described above.

4.7 Radon, Landfill Gas, and Fugitive Dust Investigations

McLaren/Hart performed an investigation of radon gas levels at the surface of the landfill, of the potential for VOC emissions from the landfill and of the potential for transport of radionuclides and trace metals in fugitive dust derived from Areas 1 and 2. The scope of these activities, methodologies used, and the results of these investigations are described in detail in the Radon Gas, Landfill Gas and Fugitive Dust Report - West Lake Landfill Areas 1 & 2 (McLaren/Hart, 1996d). In addition, as part of the supplemental field investigation activities described in the ASAP, EMSI completed a radon flux measurement program in June 1997.

4.7.1 Purpose and Scope of Investigations

McLaren/Hart completed investigations regarding radon gas, landfill gas, and fugitive dust to provide data on the potential for migration of constituents of concern via the air pathway for the health based risk assessment. The scope of the investigation included:

- Collection and analysis of radon samples from the surface of the landfill in Areas 1 and 2;

- Collection and sampling of soil vapor for methane analysis for health and safety purposes at each of the planned boring locations;

- Collection and analysis of soil samples to evaluate the potential for emission of volatile organic compounds and to assess the potential for radionuclide and trace metal transport in fugitive dust; and

- Collection of fugitive dust samples upwind and downwind of Areas 1 and 2.

4.7.2 Summary of Methods and Procedures Used

The RI/FS Work Plan included procedures for the McLaren/Hart radon sampling effort but not the landfill gas and fugitive dust activities covered in this Section. The RI/FS Work Plan required that radon activity data be collected to assess the radon flux from the surface of the landfill. Specific locations for the radon sampling effort were proposed by McLaren/Hart in their letter of June 22, 1995 (McLaren/Hart, 1995c) and approved by EPA in their letter of September 11, 1995 (EPA, 1995c). Although the Work Plan specified the procedures to be used for performing the radon measurements, it was determined by McLaren/Hart, after the sampling exercise was completed in accordance with the Work Plan, that only radon concentration values could be derived from the data. A discussion of the radon sampling methodology used and results obtained by McLaren/Hart is presented in the Radon Gas, Landfill Gas and Fugitive Dust Report (McLaren/Hart, 1996d). As radon flux estimates could not be obtained from the McLaren/Hart effort, radon flux measurements were obtained by EMSI as part of the ASAP activities. Based on the data quality objective set forth in the RI/FS Work Plan and as further discussed below, the RI evaluations of radon occurrences and flux are based on the radon flux measurements obtained by EMSI.

The radon flux measurement program completed by EMSI employed the Large Area Activated Charcoal Canisters (LAACC) method presented in Method 115, Appendix B, 40 CFR, Part 61. This method was established to measure radon flux values on uranium mill tailing piles. Radon flux was measured rather than concentration because no structures are present in either Area 1 or Area 2 that would result in the buildup of radon concentrations. Instead, the potential transport pathway for radon is the migration of the gas through the atmosphere.

The protocols used for the LAACC radon flux measurement program and calculations are included in Appendix A of the ASAP. These protocols are contained in the USEPA report *Radon Flux Measurements on Gardinier and Royster Phosphogypsum Piles near Tampa and Mulberry, Florida* (USEPA, 1986). Specific protocols used by Tellco Environmental, the EMSI subcontractor that provided the LAACCs and performed the calculations to determine radon flux, are also included in Appendix A of the ASAP (EMSI, 1997a).

4.7.2.1 Radon Sampling

The radon flux measurements performed by EMSI were made at 54 locations in Areas 1 and 2 and the Ford property (Figure 4-14). Radon flux measurements were obtained adjacent to each of the statistically unbiased random boring locations within the grids established for the soil sampling programs within Area 1 (one sample in each of 22 grids) and Area 2 (one sample in each of 32 grids). Each sample in Area 1 was representative of the 38,250 square foot area within individual 170 foot by 225 foot grids. Each sample in Area 2 was representative of the 67,600 square foot area within individual 260 foot by 260 foot grids. A 10-inch diameter LAACC charged with 180 grams of baked activated charcoal was placed on the soil surface adjacent to each of the 54 random boring locations and allowed to collect radon for a 24-hour time period. After receipt in the laboratory, each sample of exposed charcoal was weighed and radon was measured by means of gamma spectroscopy. Radon flux was calculated using the equations contained in Appendix A of the ASAP.

4.7.2.2 Soil Vapor Sampling

As was previously described in the discussion of the soil investigation activities, soil vapor sampling was completed at each proposed boring location to measure methane concentrations for health and safety considerations. The locations at which methane gas concentrations were obtained are shown on Figures 4-15 and 4-16. Sampling was completed using a geoprobe unit with the samples collected in glass sampling bulbs and analyzed onsite for methane. The resulting data (Table 4-7) was then assessed to determine if any special precautions related to potential explosive hazards needed to be followed at any of the drilling locations. Due to the transient nature of methane occurrences and possible changes in the layout and operation of the landfill gas extraction system, the actual methane levels that may be present at these or other locations in Areas 1 and 2 can vary significantly from those reported in 1995. Given that the site is a municipal solid waste landfill, the presence of methane and other landfill gases should be expected. Therefore, although the results obtained in 1995 may be useful for planning purposes, design and implementation of remedial measures and health and safety activities should be based on the results of actual landfill gas measurements obtained as part of these activities.

4.7.2.3 Soil Sampling for Non-Radiological Compound Vapor Discharge

Surface soil samples were collected at a depth of 24 inches below the ground surface for VOC and SVOC analyses. Surface samples (0 - 2 inches) were collected and analyzed for PCBs and pesticides. Both sets of samples were collected from 15 of the 50 planned soil boring locations including five borings in Area 1 and ten in Area 2. In addition, surface soil samples were also collected from the five hand auger borings completed in the closed topographic depression in the northern portion of Area 2.

4.7.2.4 Fugitive Dust Sampling

Specific protocols for fugitive dust sampling were not included in the RI/FS Work Plan. McLaren/Hart prepared a detailed plan for the fugitive dust sampling effort and submitted this plan to EPA in a December 4, 1995 letter (McLaren/Hart, 1995f). EPA approved this plan prior to the start of the field activities (EPA, 1995e).

McLaren/Hart completed the fugitive dust sampling on April 11, 1996. Samples were collected at locations in both Area 1 and Area 2 that were upwind and downwind of previously defined radiologically affected areas (Figures 4-17 and 4-18). All samples were collected within 40 feet of the radiologically affected areas to simulate worst-case scenarios. The fugitive dust samplers were operated for an 8-hour period and the samples were collected on closed-face filter cassettes, sealed, and submitted to the laboratories for analyses.

4.7.3 Deviations from Work Plan

There were no deviations from the RI/FS Work Plan, the December 4, 1995 Fugitive Dust Sampling Plan (McLaren/Hart, 1995f) or ASAP (ESMI, 1997a) that were not approved by EPA prior to the onset of sampling.

4.7.4 Summary of Results

Although the procedures set forth in the RI/FS Work Plan were followed, the results from the initial, radon-flux measurement effort performed by McLaren/Hart were reported as a concentration rather than flux. Radon Detection Systems, Inc., the company completing the work, could not calculate flux values from the data collected; therefore, the flux measurements could not be obtained as required in the RI/FS Work Plan. As a result, a supplemental radon flux measurement program was performed by EMSI as previously described.

Results from the supplemental radon flux measurement program performed by EMSI indicated the following:

- Radon flux values for Area 1 ranged from 0.1 to 245.9 pCi/m^{2}s. The average radon flux for Area 1 was 13 pCi/m^{2}s. The majority of the radon flux from Area 1 was generated from two discrete locations: WL-102 (245.9 pCi/m^{2}s) and WL-106 (22.3 pCi/m^{2}s); and

- Radon flux values for Area 2 ranged from 0 to 513.1 pCi/m^{2}s. The average radon flux for Area 2 was 28 pCi/m^{2}s. The majority of the radon flux from Area 2 was generated from two discrete locations: WL-209 (513.1 pCi/m^{2}s) and WL-223 (350.2 pCi/m^{2}s).

Results of the methane gas survey are presented on Figures 4-15 and 4-16. The methane data from the soil vapor study was used in the preparation of the drilling health and safety plan. These data were not obtained for site characterization purposes and therefore are not considered in the RI.

A total of 15 surface soil samples (five from Area 1 and ten from Area 2) were analyzed for VOCs and SVOCs. The only VOCs detected in any of these samples were acetone at 34 ppb in the surface sample from boring WL-108, 42 ppb of 1,4 dichlorobenzene in the surface sample from boring WL-114, and 38 ppb acetone and 6.5 ppb 1,4 dichlorobenzene in the surface sample from WL-209. Bis(2-ethylhexyl) phthalate, a common laboratory contaminant, was detected at levels ranging from 0.40 to 77 ppm (estimated value) in seven of the fifteen surface samples. Di-n-octyl phthalate was detected at 3 and 12 (estimated value) ppm in two of the fifteen surface soil samples. The only other SVOC detected in any of the fifteen surface soil samples was 0.92 ppm of fluoranthene that was detected in the surface sample from boring WL-218. Aroclor 1254 was detected in three (WL-114, WL-209 and WL-210) and pesticides were detected in three (WL-209, WL-222 and WL-235) of the fifteen surface soil samples. Total petroleum hydrocarbons (TPH) in the motor oil range were detected in nine of the fifteen surface soil samples and TPH diesel was detected in one of the fifteen surface soil samples. Based upon the distribution of VOCs and SVOCs in the surface soil samples, McLaren/Hart concluded "potential release of VOCs and SVOCs to the atmosphere does not appear significant for the site". McLaren/Hart reached the same conclusion for petroleum hydrocarbons, pesticides, and PCBs.

Trace metals were detected above background levels in eleven of the fifteen surface soil samples, two in Area 1 and nine in Area 2. The greatest number of exceedances and the greatest magnitude of exceedances occurred in the surface soil samples from borings WL-114, WL-206, WL-209 and WL-210. Exceedances of background levels were detected most frequently for copper (10 of 15 samples) and lead (8 of 15 samples). Additional discussion of trace metal occurrences is presented in Section 8 of this report. Although trace metals were present in surface soils at levels above background, trace metals were not detected in either the upwind or downwind fugitive dust samples obtained from either Area 1 or Area 2.

Review of the radiological data from the fugitive dust samples indicated that there were no significant differences between the upwind and downwind sampling results in either of the two radiological areas. Since these samples were collected within 40 feet of previously defined radiologically affected areas to simulate worst-case scenarios, it can be concluded that there should be no radiological release from fugitive dust at the landfill boundary.

4.7.5 Data Quality Issues

As previously discussed, the initial radon data results could not be used to calculate radon flux values as required by the RIFS Work Plan. As a result, radon flux measurements were performed as part of a supplemental field effort. No data quality issues were identified in conjunction with the evaluation of the results of the supplemental radon flux measurements performed by EMSI. No data quality issues were identified with the surface soil sample analytical results. No data quality issues were identified with the fugitive dust sampling results.

4.7.6 Outstanding Issues Or Items

No outstanding issues remain with respect to radon, landfill gas, and fugitive dust investigations.

5.0 PHYSICAL CHARACTERISTICS OF THE STUDY AREA

This section of the RI describes the physical setting and characteristics of the landfill area. The discussions presented below address the climatic conditions of the area, current and potential land uses at and around the landfill, topography and surface features, vegetation and wildlife present in the area, geologic conditions and hydrogeologic conditions in the vicinity of the landfill.

5.1 Climate

The climate of the landfill area is typical of the Midwestern United States with a modified continental climate that has four distinct seasons.

5.1.1 Temperature

Winter temperatures are generally not severe with the first frost usually occurring in October and freezing temperatures generally not persisting past March. Records since 1870 show that temperatures drop to zero (0°F) or below an average of two or three days per year. Temperatures remain at or below freezing (32°F) less than 25 days in most years.

Summers in the St. Louis area are hot and humid. The long-term record since 1870 indicates that temperatures of 90 degrees Fahrenheit or higher occur on about 35 to 40 days per year. Extremely hot days of 100 degrees Fahrenheit or more generally occur no more than five days per year.

5.1.2 Precipitation

Normal annual precipitation based on records dating back to 1871 is a little less than 34 inches. Normal monthly precipitation as measured at nearby Lambert Field International Airport is presented on Figure 5-1. Lambert field is located approximately 3.7 miles east of the landfill.

The three winter months are usually the driest, with an average total of approximately 6 inches of precipitation. Average snowfall per winter season is slightly greater than 18 inches. Snowfall of an inch or more is received on five to ten days in most years. Record snowfall accumulation over the past 30 years was 66.0 inches recorded during the 1977 –78 winter season.

The spring months of March through May are the wettest with normal total precipitation of just under 10.5 inches. Thunderstorms normally occur 40 to 50 days per year. During any given year, a few of these storms can be classified as severe with hail and damaging wind. Tornadoes have occurred in the St. Louis area.

5.1.3 Wind Distribution

Between December and April, the predominant wind direction at Lambert Field is from the northwest and west-northwest. Throughout the remainder of the year, the predominant wind direction is from the south. Considering potential differences in topography between Lambert Field and the landfill, the actual wind directions at the landfill may be slightly different, possibly skewed in a northeast-southwest direction parallel to the Missouri River valley.

5.2 Land Use

The landfill is located in a predominately industrial area. The southern portion of the landfill is zoned M-1 (manufacturing district, limited). The southernmost portion of the landfill is permitted for active sanitary landfill operations (Permit No.118912). Although the northern portion of the landfill area is zoned R-1 (one family dwelling district), residential land use has been precluded at the West Lake Landfill (including Areas 1 and 2) by restrictive covenants recorded in May 1997 by each of the fee owners against their respective parcels. These restrictive covenants also prohibit use of groundwater from beneath the landfill. Construction work, commercial and industrial uses have also been precluded on Areas 1 and 2 by a Supplemental Declaration of Covenants and Restrictions recorded by Rock Road Industries, Inc. prohibiting the placement of buildings and restricting the installation of underground utilities, pipes and/or excavation upon its property. These deed restrictions cannot be terminated without the written approval of the then-owners, MDNR and EPA.

The property to the north of the landfill, across St. Charles Rock Road, is moderately developed with commercial, retail and manufacturing operations. The Earth City industrial park is located adjacent to the landfill on the west, across Old St. Charles Rock Road. The nearest residential development, "Spanish Village", is located to the south of the landfill near the intersection of St. Charles Rock Road and I-270, approximately ¾ mile from Area 1 and one mile from Area 2. Mixed commercial, retail, manufacturing and single family residential uses are present to the southeast of the landfill. The land use zoning for the landfill and surrounding area is shown on Figure 3-4.

5.3 Surface Features

This section includes a description of the landfill topographic conditions, surface soil conditions, runoff drainage patterns, and surface water bodies in the area.

5.3.1 Topography

The landfill is situated on the eastern edge of the Missouri River floodplain. The Missouri River is located approximately two miles to the west of the landfill. The river flows in a predominantly north-northeasterly direction in the vicinity of the landfill at an elevation of approximately 425 feet based on the National Geodetic Vertical Datum (NGVD). The river is separated from the surrounding areas by a levee system constructed to an average elevation of approximately 435 to 440 feet in this area (McLaren/Hart, 1994).

The landfill is located in an area that is transitional between the floodplain immediately to the west and the loessial bluffs approximately one-half mile to the east. The edge of the Missouri River valley is oriented north to south in the vicinity of the landfill. Prior to development of the landfill, the edge of the river valley was present near the center of the landfill. As a result of placement of landfill materials, the higher topography associated with the loessial bluffs to the east has been extended further to the west.

The topography of the area around the landfill is gently rolling ranging in elevation from approximately 430 to 500 feet (NGVD). Ground elevations (exclusive of the quarry areas) range from approximately 450 to 500 feet (NGVD) at the landfill. The topography of the area has been significantly altered by quarry activities in the eastern portion of the landfill area, and by placement of mine spoils (unused quarry material) and landfill materials in the western portion of the landfill area.

Area 1 is situated on the north and western slopes of a topographically high area within the landfill. Ground surface elevation varies from 490 feet above mean sea level (AMSL) on the south to 452 feet at the roadway near the landfill property entrance.

Area 2 is situated between a topographic high of landfilled material on the south and the Ford property on the north. The highest elevations are in the southwest of Area 2 where the flank of the topographic high of landfilled materials extends into this area. The topographic high in this area has a maximum elevation of approximately 500 feet sloping to approximately 470 feet near the top of the landfill berm along the south side of the Ford property. The northern portions of the landfill are bounded by a large berm. As a result, the upper surface of Area 2 is located approximately 20 to 30 feet above the adjacent Ford property on the north and west and the north surface water body (discussed in Section 5.3.3 below) that is located in the northernmost corner of the landfill. The ground surface of Area 2 is approximately 30 to 40 feet higher than the water surface in the flood control channel (discussed in Section 5.3.3 below) that is located to the west of Area 2.

The majority of Area 2 slopes to the north-northeast; however, the surface is irregularly graded with elevations varying from 460 to 480 feet. A large topographic depression is located near and along the northern berm of the landfill. The elevation of the bottom of this closed depression is 456 feet.

5.3.2 Surface Soils

According to the U.S. Soil Conservation Service (SCS), surficial soils along the floodplain of the Missouri River generally consist of Blake-Eudora-Waldron association while the surficial soils on the bluffs east of the river are the Urban Land-Harvester-Fishpot association (SCS, 1982). The floodplain materials are described as nearly level, somewhat poorly drained to well drained, deep soils formed in alluvial sediment. The upland materials are urban land and nearly level to moderately steep, moderately well drained to somewhat poorly drained, deep soils formed in silty fill material, loess and alluvium which are formed on uplands, terraces, and bottom lands.

Soils in the area of the landfill consist of the Freeburg-Ashton-Weller association, which are nearly level to gently sloping, somewhat poorly drained, deep soils formed in loess and alluvial sediment. The Freeburg silt loam is found on the terrace adjacent to the eastern landfill boundary, while the Ashton silt loam is found to the east and south of the south pit (including the landfill borrow area).

The Freeburg unit is identified as a somewhat poorly drained silt loam to silty clay loam, up to 60 inches thick. The permeability of this soil is characterized by the SCS as moderately slow (about 10^{-4} centimeters per second [cm/sec]), and the surface runoff is medium. According to the SCS, a perched water table is often present within this unit in the Spring at a depth of 1.5 to 3 feet. The Freeburg unit's suitability for landfill cover material is described as fair due to its clay content (12 to 35%) and wetness.

The Ashton unit is a well-drained silty loam to silty clay loam, also up to 60 inches thick. The permeability of this unit is also moderately slow and the surface runoff is medium. The suitability of the Ashton unit for landfill cover material is described as fair due to the clay content (10 to 40%).

Soil materials present as cover materials in and on the surface of Areas 1 and 2 were derived primarily from onsite materials and from quarry fines consisting primarily of shale materials. The only known exception to the use of on-site soils was the reported use of approximately 39,000 tons of soil mixed with 8,700 tons of leached barium sulfate originating from uranium-ore processing operations which the landfill owner and operator believe were used as cover materials.

5.3.3 Surface Water

Surface water runoff patterns for Areas 1 and 2 are presented on Figure 4-1. Runoff from Area 1 ultimately flows into the surface water body located north of Area 2 (the north surface water body). Runoff from Area 2 flows into a closed topographic depression located behind the landfill berm, into the north surface water body, or to the south down the landfill access road and ultimately into the north surface water body. A very limited volume of runoff may flow through the breach in the Area 2 berm down the landfill slope and onto the margin of the Ford property. As discussed below, a portion of Area 2 is bounded by the flood control channel; however, no runoff from Area 2 flows into this water body.

5.3.3.1 Area 1 Drainage

The majority of the runoff from Area 1 ultimately flows into the north surface water body. Four locations (Weirs 1, 2, 3, and 4) where rainwater runoff flows from Area 1 were identified (Figure 4-13). All four locations are located in the northern portion of Area 1 and discharge into the drainage ditch located on the south side of the landfill entrance road. Flow in this ditch occurs in a northeasterly direction and exits the West Lake property through a culvert beneath the entrance road near the property fence-line. From here, runoff flows in a ditch located along the west side of St. Charles Rock Road and ultimately into the north surface water body located at the northernmost end of the landfill.

As was discussed previously, the ground surface of Area 1 is irregular and some of the runoff flows into and accumulates in several small topographic depressions in this area. Standing water of up to six inches in depth has been reported to be present in these topographic lows following precipitation events.

5.3.3.2 Area 2 Drainage

The majority of the runoff from Area 2 flows into the closed topographic depression located in the southeastern portion of Area 2. McLaren/Hart (1996b and 1996e) identified five locations at which runoff flows offsite from Area 2. Three of these locations (Weirs 5, 6 and 7) are at the top of the slope above the landfill berm in the western portion of Area 2 above the buffer on the Ford property. These locations were identified by the presence of erosional runnels. With the exception of one heavy storm in mid-May 1995, flow was only observed at one of these locations. This location, Weir 5, is located in the vicinity of the historic berm failure and resulting erosional runoff that led to the accumulation of radiological impacted soil in the southern portion of the Ford property (Figure 4-13). At the other two locations, water has to pond up to a height sufficient to over-top a berm at the top of the landfill slope before any flow will occur. Based on observations made throughout the course of the RI field investigations, it was concluded by McLaren/Hart that this is not a frequent occurrence. Observations made by EMSI also support this conclusion.

Two additional locations (Weirs 8 and 9) of offsite flow are located in the southern portion of Area 2 near the roadway in the area used for storage of roll-off bins (Figure 4-13). These areas appear to be areas where runoff occurs primarily as sheet flow and extensive erosional runnelling was not observed in this area. Runoff from the roll-off storage bin area and the demolition landfill area commingles with runoff from Area 2 near Weirs 8 and 9.

In the summer of 1997, weir 10 was installed downslope from weirs 8 and 9. Monitoring of storm events had indicated that only ponded water was present at weirs 8 and 9. As a result, only ponded water had been obtained from these locations. Weir 10 was subsequently installed to attempt to sample flowing runoff from this area. However, in placing weir 10 further downslope from weirs 8 and 9, the runoff flowing through weir 10 is a combination of runoff from both Area 2 and other areas outside of Area 2.

5.3.3.3 Off-Site Surface Water

There are two surface water bodies present in the vicinity of OU-1. These are the north surface water body and the flood control channel associated with Earth City (Figure 4-13). There are two additional surface water bodies present, the surface water detention pond and the leachate lagoon that are associated with the current landfilling operations. As discussed above, runoff from Area 2 has not reached the flood control channel. In addition, the surface water detention pond and the leachate lagoon are all hydraulically isolated from Area 1 and Area 2 so they cannot receive any surface water runoff from these regions.

The north surface water body receives water from the drainage ditch that separates St. Charles Rock Road from the landfill. The body contains water throughout the year. Measurements made by McLaren/Hart indicate a water level fluctuation between approximately 435.4 and 437.3 feet (NVGD).

The flood control channel is part of an extensive set of interconnected channels that are used to manage stormwater runoff within the Earth City Industrial Park. The water level in the flood control channel varies throughout the year in response to variations in precipitation and changes resulting from pumping by Earth City of water from the flood control channel to the Missouri River. Measurements made by McLaren/Hart indicate a water level fluctuation between approximately 432.5 and 434.5 (NVGD).

5.4 Biota

An assessment of the plant communities present at the landfill, the potential for the presence of threatened or endangered species and a description of the types of wildlife observed to be present at the landfill was performed by McLaren/Hart (1996c) as part of the RI/FS investigations. The results of this survey are presented in the McLaren/Hart report and are briefly summarized below.

5.4.1 Plant Communities

Three types of plant communities were identified in Areas 1 and 2. Plant species identified in both areas are summarized in Table 5-1. These include old field and hydrophilic plant communities identified in both Areas 1 and 2 and a forest plant community identified in Area 2 only. The old field plant community consists of open areas dominated by weedy species such as herbs, grasses and occasional sun-loving, fast-growing trees. Old fields typically contain annual, biannual and perennial herbaceous plants, mixed among grasses and a few pioneer woody species (Kricher and Morrison, 1988). The hydrophilic communities are defined as areas, irrespective of size, that contain ponded water or vegetation typically adapted for saturated soil conditions. Forested plant communities are dominated by woody plant species (trees) that have a well-developed canopy and under-story (Kricher and Morrison, 1988).

A fourth plant community, a maintained field community, was identified in areas adjacent to the landfill. Maintained field communities consist of open areas dominated by grass species. These areas are maintained by mowing at a frequency of approximately once per year.

5.4.1.1 Area 1 Plant Communities

Area 1 consists predominantly of old field community dominated by grasses and various herbaceous plant species interspersed with six small depressions dominated by hydrophilic vegetation (Figure 4-2). The old field community in Area 1 was dominated by various grass species such as bluestem, foxtail, and other grasses. Other dominant herbaceous species noted include goldenrod, nodding thistle and curled dock. Other species noted included common plantain and field pennycress. No woody species were observed to be dominant in Area 1.

Six small isolated areas of hydrophilic plant communities were identified in Area 1 (Figure 4-2). These species included herbaceous vegetation such as rushes, curled dock, and cattail. A green alga, Sprirogyra spp., was also present in two areas in which standing water was observed. All of the hydrophilic communities were present in small surface depressions in the landfill cap that likely are the result of differential landfill subsidence over time and resultant poor surface drainage.

5.4.1.2 Area 2 Plant Communities

Area 2 plant communities include an old field community, a forested berm area dominated by woody vegetation and small isolated hydrophilic communities containing cattails and other hydrophilic species (Figure 4-3). The old field plant community dominates the majority of Area 2. This community is present over the majority of the landfill surface between the landfill berm on the north and west margins of this area and the active landfill operations located to the east and south of this area. The old field community in Area 2 was dominated by invasive herbaceous species such as nodding thistle, yellow sheet clover and goldenrod. Various grass species were also noted to be present. Woody species including numerous young stands of staghorn sumac and eastern cottonwoods were also present in Area 2.

The landfill berm along the north and west boundaries of Area 2 contains a forest plant community. This community consists of predominantly woody species including eastern cottonwood, willows, dogwoods and ash trees. A species of grape was the dominant vine present in the forested community of Area 2. Bedstraw and other old field species are present along the edge habitat between the forest community and the old field community.

Ten small isolated areas containing plant species typical of hydrophilic communities were identified in Area 2 (Figure 4-3). In most of these areas, cattails were the only, or the dominant species present. Similar to Area 1, these areas are present in small depressions presumably the result of differential settlement in the landfill cap and resultant obstruction of the surface water drainage in these areas.

5.4.1.3 Plant Communities in Other Areas at or Near the landfill

Plant communities were characterized for three other areas adjacent to Areas 1 and 2. These include the north surface water body, the south flood control channel and the uncultivated portion of the Ford property north of Area 2.

The north surface water body is located to the northeast of Area 2 at the northernmost corner of the landfill property. A forest-type plant community that includes eastern cottonwoods, ashes, dogwoods, and willows dominate the edges of this surface water body. The canopy cover and under-story are dense in the vicinity of Area 2. The vegetation associated with the north surface water body is a continuation of the adjacent plant community located on the landfill berm on the north and west margins of Area 2. The banks of the north surface water body are not well defined and at the time of the plant assessment, water flow appeared to be very slow to non-existent in the north surface water body.

The south flood control channel is located off of the landfill on property associated with the Earth City development. A fence restricts access to the landfill from or to the south flood control channel. The south flood control channel consists of well-defined, man-made bed and banks. The shores of the flood control channel consist of a maintained field community.

The Ford property located to the north and west of Area 2 consists of an old field community. This area is not currently farmed and has not been farmed since the 1980's. Dominant plant species in this area include nodding thistle, goldenrod, daisy fleabane, yellow sweet clover and various grasses.

5.4.2 Threatened and Endangered Species

Federal and State listings of threatened and endangered species were requested from the U.S. Fish & Wildlife Service (USFWS) and from the Missouri Department of Conservation (MDOC) by McLaren/Hart as part of their activities related to preparation of the RI/FS Work Plan (McLaren/Hart, 1994). The USFWS responded that "No federally-listed endangered or threatened species occur in the project area" (USFWS, 1994). The MDOC responded that "Department staff examined map and computer files for federal and state threatened and endangered species and determined that no sensitive species or communities are known to occur on the landfill property or surrounding area" (MDOC, 1994).

Subsequent to these letters, Ms. Cherri Baysinger-Daniels of the Missouri Department of Health (MDH) stated that on October 23, 1994 she observed a Western Fox Snake (*Elaphe vulpina vulpina*), a Missouri state-listed endangered species, at the landfill. The western fox snake is a marsh-dwelling member of the rat snake group (MDOC, 1992). This snake is believed to be an inhabitant of open grasslands and the borders of woods. In Missouri, the fox snake has been found near large natural marshes (MDOC, 1992). The western fox snake has currently been documented to be present only in St. Charles and Lincoln counties (MDOC, 1994 and 1995).

In response to Ms. Baysinger-Daniels' observation, McLaren/Hart requested another data base search of the western fox snake's distribution in Missouri (McLaren/Hart, 1996c). This second search indicated that there were no records of occurrences of the western fox snake reported for St. Louis County, Missouri. If Ms. Baysinger-Daniels' preliminary observation had been verified, the presence of the western fox snake at the landfill would represent a new location for this species and a new county record. A voucher specimen is required to adequately document a new county record (MDOC, 1995). A photograph of a specimen, showing both the dorsal and ventral views, would suffice as a voucher specimen (MDOC, 1995). As a voucher specimen was not obtained, Ms. Baysinger-Daniels' observation alone is insufficient to verify an occurrence of the western fox snake in St. Louis county.

During the field survey, McLaren/Hart examined areas most likely to be inhabited by the western fox snake in an effort to verify and document Ms. Baysinger-Daniels' observation. Each vegetative community, with emphasis on marshy areas, was qualitatively examined for the presence of the western fox snake or other reptiles. The reptile search was performed concurrently with the evaluation of the vegetative communities. Basking areas, large rocks, logs and pieces of plywood were examined for the presence of snakes. No specimens of the western fox snake were observed during the biological survey or during any of the other RI/FS field investigations.

5.4.3 Area Wildlife

Numerous species and signs of species of wildlife were observed to be present in the landfill area during the activities associated with the biological survey. Deer tracks (*Odocoileous spp.*) were noted by McLaren/Hart (1996c) in Radiological Area 2 and on the adjacent Ford property. Based on the home range of deer, it is likely that all areas of the landfill are accessible to this species. Rabbits (*Sylvilgus floridanus*) or signs of rabbits were observed in Radiological Areas 1 and 2, areas surrounding the north surface water body and the Ford property. It is likely that rabbits are cosmopolitan throughout the landfill and surrounding area. Other cosmopolitan species include red-winged black birds (*Aeqlaius phoeniceus*), robins (*Turdus migratorius*) and occasionally crows (*Corvus brachynchos*).

A great blue heron (*Ardea herodias*), a piscivorous bird, was observed flying above the landfill and landing in the south flood control channel (McLaren/Hart, 1996c). This species is likely to use aquatic habitats both on and offsite, but it will feed only in those waters containing prey species of fish and amphibians.

Several pellets containing fur were observed in Areas 1 and 2 and a relatively large den was observed in the landfill berm along the northwest side of Area 2 (McLaren/Hart, 1996c). These pellets and the den were possibly due to coyotes (*Canis latrans*), red fox (*Vulpes*) or possibly both. The home range of these species is large enough to include the entire landfill and the presence of rabbits suggests a food source for these species (McLaren/Hart, 1996c).

5.5 Subsurface Features

The subsurface conditions beneath the landfill consist of municipal refuse, construction and demolition debris, other wastes and the associated soil cover materials, alluvial deposits and limestone, dolomite and shale bedrock.

5.5.1 Geology

The bedrock geology of the landfill area consists of Paleozoic age sedimentary rocks that in turn overly Pre-Cambrian age igneous and metamorphic rocks. The Paleozoic bedrock is overlain by unconsolidated alluvial and loess deposits of recent (Holocene) age. A generalized stratigraphic column for the St. Louis area is presented on Figure 5-2.

5.5.1.1 Bedrock Geology

The lowermost bedrock units beneath the landfill area consist of Pre-Cambrian igneous and metamorphic rocks that are overlain by cherty dolomite, siltstone, sandstone and shale of Cambrian age. These deposits are overlain by approximately 2,300 feet of limestone, dolomite, shale and sandstone of Ordovician age which in turn are overlain by approximately 200 feet of cherty limestone's of Silurian age. Devonian age sandstone, limestone and shale deposits lie unconformably on the Silurian age deposits.

The uppermost bedrock units in the vicinity of the landfill consist of Mississippian age limestone and dolomite with inter-bedded shale and siltstone layers of the Kinderhookian, Osagean, and Meramecian Series. The Kinderhookian Series is an undifferentiated limestone, dolomitic limestone, shale and siltstone unit ranging in thickness from 0 to 122 feet in the St. Louis area. The Osagean Series consists of the Fern Glen Formation, a red limestone and shale, and the Burlington-Keokuk Formation, a cherty limestone. The Fern Glen Formation ranges in thickness from 0 to 105 feet and the Burlington-Keokuk Formation ranges from 0 to 240 feet thick in the St. Louis Area.

The Meramecian Series overlies the Osagean Series rocks. The Meramecian Series consists of several formations including the Warsaw Formation, the Salem Formation, the St. Louis Formation, and the St. Genevieve Formation. The St. Genevieve Formation is reportedly not present in the vicinity of the landfill (Golder, 1996a).

Pennsylvanian-age Missourian, Desmoisian, and Atokan formations are present in some areas above the Mississippian-age rocks. The Pennsylvanian-age rocks consist primarily of shale, siltstone, and sandstone with silt and clay. These formations range in combined thickness from 0 to 375 feet in this area. The Atokan-Series Cheltenham Formation was identified as being present in the landfill soil borrow area located in the southeastern corner of the landfill.

The following sub-sections provide additional detailed information regarding the uppermost bedrock units beneath the landfill. Additional information on the bedrock conditions beneath the landfill is contained in the *Physical Characterization Technical Memorandum for the West Lake Landfill, Operable Unit 2, Bridgeton, Missouri* prepared by Golder Associates, Inc. (1996a).

5.5.1.1.1 Keokuk Formation

Four boreholes drilled by Golder Associates Inc. (Golder) penetrated into the Keokuk Formation. Based on information obtained from these boreholes, the Keokuk Formation beneath the landfill was generally identified as a fresh to slightly or moderately weathered, thin- to medium-bedded, very light gray to light olive, medium- to coarse-grained, medium strong, fossiliferous limestone (Golder, 1996a). Dolomite and dolomitic limestone beds as well as chert layers and nodules were observed by Golder (1996a) to be present with the Keokuk Formation. The limestone units of the Keokuk Formation were variously described as siliceous and arenaceous (sandy) as well as porous and vuggy.

Fractures were infrequently (generally less than two fractures per foot) identified in the Keokuk Formation and were generally described as irregular and rough (Golder, 1996a). Some fractures were reported to be bedded and planar (Golder, 1996a). Golder (1996a) identified open vugs and/or porous zones in the lower portion of the formation below an elevation of 100 feet above mean sea level (AMSL).

The Keokuk Formation was encountered in the site boreholes at depths of 365 to 375 feet below ground surface along the eastern edge of the active sanitary landfill at elevations ranging from 115 to 126 feet AMSL (Golder, 1996a). Along the western edge of the active sanitary landfill, the Keokuk Formation was encountered at depths of approximately 345 feet below ground surface (elevation of 115 feet AMSL).

5.5.1.1.2 Warsaw Formation

The Warsaw Formation was generally described as being a fresh and thickly bedded limestone with numerous beds of calcareous claystone and fossiliferous limestone beneath the landfill (Golder, 1996a). Various portions of the Warsaw Formation were described by Golder (1996a) as arenaceous (sandy) or argillaceous (clayey). Many interbeds of dolomite, claystone, siltstone, clayey siltstone, and silty claystone were also observed to be present (Golder, 1996a). The limestone beds were very fine- to very coarse-grained or micro- to coarsely crystalline ranging in color from dark greenish gray to olive black (Golder, 1996a). The beds of this formation were characterized by vuggy porosity (Golder, 196a).

The lower portion of the Warsaw Formation is reported to consist primarily of thin- to medium-bedded limestone, which includes thin chert layers and small chert nodules. The lower portion of the Warsaw Formation grades into the upper portion of the Keokuk Formation. The upper portion of the Warsaw Formation was characterized by a 2.5 to 10 foot thick claystone or siltstone layer commonly referred to as the Warsaw Shale (Golder, 1996a).

Fractures in the Warsaw Formation were rare and generally did not exceed a frequency of one fracture per foot (Golder, 1996a). Fractures observed by Golder (1996a) were reported to be generally jointed, irregular or planar, and rough or smooth. Clay infilling of joints was common (Golder, 1996a).

The Warsaw was encountered in boreholes drilled by Golder (1996a) at about 245 below ground surface (approximately 240 feet AMSL) near the eastern edge of the active sanitary landfill. Along the western edge of the active sanitary landfill, the Warsaw Formation was encountered at depths ranging from about 200 to 210 feet below ground surface, equivalent to an elevation of about 250 to 260 feet AMSL (Golder, 1996a). These elevations reportedly roughly correspond to the base of the old quarry pit indicating that the quarrying terminated at the top of the Warsaw Formation (Golder, 1996a). The thickness of the Warsaw Formation encountered beneath the landfill area ranged from about 130 to 145 feet.

5.5.1.1.3 Salem Formation

The Salem Formation lies above the Warsaw Formation. The Salem Formation beneath the landfill area was described by Golder (1996a) as a fresh, thinly- to thickly-bedded, pale-yellowish brown to light olive gray limestone. The limestone was variously described as argillaceous or arenaceous, bioclastic, fossiliferous, or fossiliferous dolomitic limestone. Interbedded dolomitic layers were common and chert clasts, nodules and layers were scattered throughout the formation at varying frequencies (Golder, 1996a).

Fracturing is reported (Golder, 1996a) to be rare in the Salem Formation with fracture frequencies of zero to one fracture per foot in the lower portion of the formation increasing to up to two fractures per foot in the upper portion (Golder, 1996a). The fractures primarily consisted of joints with surfaces varying from irregular and rough to planar and smooth.

The Salem Formation was encountered during drilling performed by Golder (1996a) at depths of approximately 165 feet below ground surface (about 320 feet AMSL) along the eastern edge of the active sanitary landfill. Depths to the top of this formation ranged from approximately 115 to 135 feet below ground surface (about 328 to 340 feet AMSL) along the western edge of the active sanitary landfill (Golder, 1996a). The thickness of the Salem Formation ranges between 67 and 83 feet beneath the landfill area (Golder, 1996a).

5.5.1.1.4 St. Louis Formation

The primary bedrock unit beneath the landfill area is the St. Louis Formation which has generally been described as consisting of inter-bedded fresh to slightly weathered limestone and dolomite (Golder, 1996a). Based upon observations of core samples, Golder (1996a) described the St. Louis Formation beneath the landfill area as a very light gray to olive gray, fine to medium crystalline or fine- to medium-grained limestone inter-bedded or inter-layered with lesser amounts of claystone and siltstone. The limestone beds ranged from thin to very thick and were variously characterized as arenaceous, argillaceous, dolomitic, or clastic (Golder, 1996a). The St. Louis Formation grades downward into the underlying Salem Formation (Golder, 1996a).

Fractures were identified by Golder (1996a) in the core samples of the St. Louis Formation at frequencies of zero to ten fractures per foot with the fractures generally classified as jointed, irregular, or rough. The fractures were generally infilled with clay. Stylolitic (column-like) joints were also reportedly observed (Golder, 1996a).

The top of the St. Louis Formation was encountered during drilling by Golder (1996a) at depths ranging from 14 to 52 feet to between 20 and 110 feet below ground surface along the eastern and western edges of the active sanitary landfill, respectively. The elevation of the top of the St. Louis Formation ranges from between 425 and 460 feet AMSL beneath the eastern portion of the active sanitary landfill to between 379 and 442 AMSL beneath the western portion of the active sanitary landfill (Golder, 1996a). These variations in the depth to and elevation of the top of the St. Louis Formation reflect the presence of the edge of the buried Missouri River valley beneath the site and the presence of the limestone bluffs upon which the limestone quarry was sited (Golder, 1996a). The thickness of the St. Louis Formation ranges from approximately 65 to 130 in the areas adjacent to the active sanitary landfill.

5.5.1.1.5 Cheltenham Formation

The Cheltenham Formation was only encountered near the surface at one location (PZ-301-SS) in the southern portion of the former landfill borrow area which is located to the south of the landfill property, south of the active sanitary landfill. The Cheltenham Formation reportedly consists of clays and associated clastic deposits (Golder, 1996a). The clays are reported to be mostly white to light- or medium-gray purplish to red; however, at the landfill the claystone of this formation were found to be predominantly olive to greenish gray to light brownish gray (Golder, 1996a). Thin limestone, siltstone and coal beds were also present in the formation (Golder, 1996a).

At PZ-301-SS, the Cheltenham Formation was identified from 19.1 to 71.5 feet below the ground surface (Golder, 1996a). With exception of the upper 10 feet, cores obtained from this formation were relatively unfractured (Golder, 1996a).

5.5.1.2 Unconsolidated Materials

Unconsolidated materials at the landfill consist primarily of alluvium and loess. During the late Pleistocene period loess consisting primarily of windblown silt with lesser amounts of clay was eroded from glacial outwash deposits by wind action and re-deposited as windblown deposits. Loess deposits range up to 80 feet thick along the bluffs and hills to the east of the landfill; however, the loess deposits at the landfill are relatively thin (Golder, 1996a). Silty clay and clayey silt deposits were identified with thickness from 13 to 22 feet along the eastern edge of the active sanitary landfill (Golder, 1996a). Loess was not commonly encountered along the western edge of the active sanitary landfill and where encountered in the western portion of the landfill, these deposits were about 10 to 15 feet thick and were occasionally found to be interbedded with the underlying alluvial deposits.

Alluvial deposits in the landfill area typically consist of fine-grained materials (clay and silt) overlying coarse-grained (sand and gravel) materials. The coarse grained materials primarily consist of poorly sorted sands and have been interpreted to be the result of point bar deposits associated with the Missouri River (Golder, 1996a). The finer grained deposits have been interpreted to be the results of overbank deposits associated with the Missouri River floodplain. The thickness of the alluvial deposits and the depth to the top of bedrock increase from the eastern to the western portions of the landfill area. This increase in depth results from the presence of the buried alluvial valley beneath the western portion of the landfill. Along the western portion of the active sanitary landfill, in the vicinity of Area 1, the alluvial deposits are up to 120 feet thick. Figure 5-3 presents a northeast-southwest cross-section through Area 1 and Figure 5-4 presents a northeast-southwest cross-section through Area 2.

5.5.2 Landfill Deposits

The various areas of landfill activities were previously described in Section 3.2. The deposits associated with past landfilling primarily include municipal refuse, construction and demolition fill, and associated soil cover. The thickness of the landfill deposits varies from 11 to 56 feet with an average thickness of approximately 36 feet in Area 1 and approximately 30 feet in Area 2. The depth and configuration of the landfill deposits varies between each of the various areas of prior landfilling activities. The amount variation depending in part upon the pre-landfill topography and the effects of pre-landfill disturbances (e.g. mining activities) at the landfill, the amount of above-grade disposal that took place and the type of waste materials disposed. The description of the nature and configuration of the solid waste materials associated with the active landfill has been developed as part of OU-2 (Golder, 1996a and Water Management Consultants, 1997). The configuration of the radiologically impacted materials in Radiological Areas 1 and 2 are addressed as part of the discussions of source areas in Section 6 of this report.

The landfill materials consist primarily of household trash and construction and demolition debris. Based upon observations made by McLaren/Hart during the soil boring program, there appears to be minimal soil material or soil layers within the landfill debris. Where soil was encountered during the boring program, it was generally one to two feet thick or less. The soil material encountered during the boring program consisted of silt and sand with some gravel. The greatest soil thickness encountered during the boring program was found at the ground surface where the soil thickness was reported by McLaren/Hart to commonly be three to five feet thick.

With the exception of the limited information presented in the McLaren/Hart Soil Boring and Surface Sampling Report (McLaren/Hart, 1996h), little information has been developed on the nature and thickness of the soil cover that exists over Areas 1 and 2. None of the pre-RI reports contain any drilling or borehole logs or other information on the nature of the materials encountered during drilling. Borehole logs developed by McLaren/Hart as part of their drilling and well installation efforts do contain descriptions of the materials encountered; however, the soil cover materials were generally not described separately from the landfill materials as large diameter augers were used to drill these borings. Review of the field logs indicates that were the cover materials were described by McLaren/Hart's field personnel, they generally consisted of less than one to up to approximately 5-feet of sandy or clayey silt.

EMSI did drill four borings along the west side of Area 1. Soil cover materials encountered by EMSI during our drilling efforts were described as a loose, slightly moist, mottled gray, brown clayey sand grading to gray clayey sand at a depth of 30 inches. The total thickness of soil cover materials encountered at the four locations drilled by EMSI varied from approximately 24 to 60 inches.

A generalized description of the landfill cover conditions can be developed based on the limited information available from the boring logs and general observations made during the various field activities, particularly the radon flux measurements. Based on this information, the landfill cover materials over Area 1 can be described as approximately three to five feet of well-vegetated clayey sand or sandy, silty clay. The cover materials over Area 2 can be described as approximately one to two feet of well to poorly vegetated clayey, silty sand or sandy, silty clay. The soil cover over Area 2 contains some concrete chunks of other pieces of construction/demolition debris. Parts of the central portion of Area 2 contain little to no vegetative cover indicative of a thin and/or rocky cover material with limited to no ability to support vegetation.

5.6 Hydrogeology

The hydrogeology of the landfill area is dominated by a water table aquifer contained within the alluvial materials beneath the landfill and minor groundwater present within the limestone and dolomite bedrock units beneath the landfill area. Perched water is also locally present within the landfill deposits.

This section presents a brief overview of the regional hydrogeology. Additional detailed information regarding groundwater occurrences, potentiometric levels and hydraulic properties of the bedrock aquifers beneath the landfill can be found in the *Physical Characterization Technical Memorandum for the West Lake Landfill, Operable Unit 2, Bridgeton, Missouri* prepared by Golder Associates, Inc. (1996a). A detailed discussion of the hydrogeologic conditions with respect to the alluvial aquifer beneath the landfill is presented after the overview of the bedrock aquifer conditions.

5.6.1 Regional Hydrogeology

Groundwater is present in both the bedrock units and the unconsolidated materials. The major bedrock aquifers of the St. Louis area include the Cambrian-age Potosi Dolomite and the Ordovician-age Gasconade Dolomite, Roubidoux Formation and St. Peter Sandstone.

The Potosi Dolomite is up to 324 feet thick and occurs at an average depth of 2,240 feet in the St. Louis area. The Gasconade Dolomite and the associated Gunter Sandstone occur in thickness of up to 280 feet in the St. Louis area. These units are overlain by the Roubidoux Formation, which ranges from 0 to 177 feet thick in the St. Louis area. The average depth of the Roubidoux Formation is approximately 1,930 feet. The St. Peter Sandstone lies at a depth of approximately 1,450 feet below ground surface and can be as much as 160 feet thick. It should be noted that the thickness and depth of these formations vary throughout the St. Louis area, and they may not be present in some places. Due to their depth, these formations are generally not used as a source of potable water. The deeper Cambrian and Ordovician-age aquifers are separated from shallower units by the Ordovician-age Maquoketa shale that appears to provide confinement for the underlying deeper aquifers.

Miller et al. (1974) describes the uppermost regional aquifers present in the Silurian, Devonian, Mississippian and Pennsylvanian- age rocks, as yielding small to moderated quantities of water ranging from 0 to 50 gpm. The Mississippian-age Mermecian Series rocks (including the Warsaw, Salem and St. Louis Formations), that underlie and are present immediately to the west of the landfill, are not identified as favorable for groundwater development due to their generally low yield (less than 50 gallons per minute [gpm]) (Miller et al., 1974).

The major alluvial aquifers in the area are differentiated to include the Quaternary-age alluvium and the basal parts of the alluvium underlying the Missouri River floodplain. These floodplain alluvial aquifers are typically exposed at the surface and can be as much as 150 feet thick (Miller et al., 1974). Alluvial wells completed in the Mississippi and Missouri River floodplains are capable of yielding more than 2,000 gpm (Emmett and Jeffery, 1968).

5.6.2 Landfill Hydrogeology

This section describes the hydrogeologic conditions beneath and in the vicinity of the landfill. As the focus of the OU-1 hydrogeologic investigations was on the alluvial aquifer, the following discussion also focuses on the alluvial aquifer. Investigations of the bedrock aquifer conditions beneath the landfill have been performed as part of the OU-2 RI/FS effort. Results of these investigations are summarized in the *Physical Characterization Technical Memorandum for the West Lake Landfill, Operable Unit 2, Bridgeton, Missouri* prepared by Golder Associates, Inc. (1996a) and the *Site Characterization Summary Report for West Lake Landfill, Operable Unit 2, Bridgeton, Missouri* prepared by Water Management Consultants, Inc. (1997).

5.6.2.1 Groundwater Occurrence

The landfill is located on the eastern edge of the historic Missouri River Valley along the transition between the alluvial floodplain to the west and the loess bluffs to the east. Alluvial deposits of varying thickness underlie Radiological Areas 1 and 2. Based on the results of the soil borings, the thickness of the landfill debris beneath Areas 1 and 2 varies from 11 to 56 feet, with an average thickness of approximately 36 feet in Area 1 and approximately 30 feet in Area 2. The underlying alluvium increases in thickness from east to west beneath Area 1. The alluvial thickness beneath the southeastern portion of Area 1 is less than 5 feet (bottom elevation of 420 feet AMSL) while the thickness along the northwestern edge of Area 1 is approximately 80 feet (bottom elevation of 370 feet AMSL). The thickness of the alluvial deposits beneath Area 2 is fairly uniform at approximately 100 feet (bottom elevation of 335 feet AMSL).

During the RI investigations, groundwater was generally encountered in the alluvium beneath the landfill materials. Groundwater generally was not encountered within the landfill deposits. Continuous groundwater was first encountered in the alluvial materials near or immediately below the base of the landfill debris. The only exception was the presence of localized zones of perched water encountered within the landfill deposits. Isolated bodies of perched water were encountered in two of the 24 soil borings drilled in Area 1 and six of the 40 soil borings drilled in Area 2 as part of the RI field investigations. The perched water generally occurs in small isolated units at depths varying from five to 30 feet below ground surface (Figure 4-10).

5.6.2.2 Groundwater Levels and Elevations

Monthly groundwater levels were measured in various wells (Figure 4-11) during the first year of the OU-1 RI investigations and on a quarterly basis during the second year. The depth to water measurements and resulting groundwater elevation data is included on Tables 4-3 and 4-4. Additional groundwater level data was obtained as part of the OU-2 RI effort and is presented in the *Physical Characterization Technical Memorandum for the West Lake Landfill, Operable Unit 2, Bridgeton, Missouri* prepared by Golder Associates, Inc. (1996a).

Water level data obtained as part of the OU-1 RI indicate that with the exception of the localized perched water conditions encountered in isolated areas within the landfill, groundwater generally occurs only in the underlying alluvium at or below the base of the landfill materials. Depths to groundwater vary from 15 to 20 feet in areas adjacent to the landfill. Exceptions were noted in wells MW-103 and MW-104 located along Old St. Charles Rock Road, adjacent to the flood control channel and in wells I-66 and I-67 located along the northeastern boundary of the landfill property, adjacent to St. Charles Rock Road. Water levels in these four wells ranged from approximately 5 to 10 feet below ground surface. Water levels beneath the landfill varied from 20 to 60 feet beneath the landfill boundaries. This difference in the depths to groundwater beneath the landfill compared to areas adjacent to the landfill is the result of the increased elevation of the surface of the landfill compared to surrounding areas.

Review of the water level data (Table 4-4) indicates that the groundwater elevations in the vicinity of the landfill vary seasonally. The lowest groundwater levels occurred during the fall and winter months (September through March) while the highest levels occurred during the spring and summer months (April through August). These variations are consistent with the variations in precipitation previously discussed.

5.6.2.3 Hydraulic Gradient

Review of the RI water level data (Table 4-4) indicates that only a very small amount of relief (less than one foot) exists in the water table surface beneath the landfill. The horizontal hydraulic gradients within the alluvial materials are very low, ranging from approximately 0.001 to less than 0.0001 feet per foot. Steeper gradients ranging up to 0.005 or more feet per foot were identified to the south-southwest of the landfill. The steeper gradients in this area result primarily from higher water levels encountered in several off-site, upgradient monitoring wells (MW-107, S-80, and PZ-300AS) present in this area. Groundwater may exist in a perched condition in this area resulting in artificially high water levels. As these wells are located offsite at distances of approximately one-half mile from the landfill boundary, the source of the higher water levels in these wells cannot be ascertained from the available data.

Figures 5-3, 5-4, 5-5 and 5-6 present the water table level elevations from the uppermost wells (shallowest) completed beneath and near the landfill. Contours of lines of equal water table elevation have been included on these maps. Only one consistent feature can be identified from review of these maps, that is the depression in the water table associated with the ongoing leachate extraction at the active sanitary landfill. Due to the low amount of relief and consequently the extremely low hydraulic gradients present beneath the landfill area, other "features" that may be identified on any one of the water table maps are not considered to be significant. These "features" are considered to be artifacts of the contour effort and are not reflective of any particular condition associated with the landfill. This is supported by the fact that, with the exception of the water table depression associated with the active sanitary landfill, the shapes of the various contours are not consistent among the various events. Therefore, the shape of the water table contours should not be strictly interpreted as a representation of the water table. The water table beneath the landfill area can best be described as extremely flat with little variation or relief.

Review of the water level data (Table 5-2) obtained from the various clusters of wells completed (screened) at different depths within the alluvium indicates that generally there is little if any vertical hydraulic gradient present within the alluvium beneath the landfill. Most of the well clusters displayed similar water levels for the shallow, intermediate and deep portions of the aquifer. Slight downward gradients (approximately 0.001 feet per foot or less) were identified in some of the well clusters during some of the monitoring events. Strong downward trends were identified in two well clusters, between wells S-80 and I-50 which are located off-site to the southwest and upgradient of the landfill, and at wells S-82, I-9, and D-93 which are located along the western boundary of the landfill near the flood control channel. Both of these well clusters displayed strong downward gradients on the order of approximately 0.25 feet per foot for the S-80 / I-50 well cluster to approximately 0.02 feet per foot for the S-82 / I-9 / D-93 well cluster.

Additional information on hydraulic gradients was obtained as part of the RI/FS effort for OU-2. The measurements obtained and evaluations performed as part of the OU-2 effort also confirm the presence of flat hydraulic gradients within the alluvial aquifer beneath the landfill. Measurements made as part of the OU-2 effort (Golder, 1996a) indicated even lower horizontal hydraulic gradients (on the order of 0.0001 feet per foot or less) than those measured as part of the OU-1 effort. Results of the OU-2 evaluations indicated that the vertical hydraulic gradients for the shallow alluvium to the intermediate or deep alluvium were generally negligible, ranging from very slightly downward to very slightly upward (Golder, 1996a).

Golder (1996a) also obtained information on the horizontal and vertical gradients within the bedrock aquifers beneath the landfill. In general, the regional horizontal gradient within the bedrock formations beneath the landfill, based on water level measurements obtained from wells completed in the Keokuk Formation, is assumed to be to the west and northwest, towards the Missouri River. In the vicinity of the active sanitary landfill, groundwater flow within the Salem and St. Louis Formations is toward the active sanitary landfill in response to the leachate collection activities at the active sanitary landfill. In general, the horizontal hydraulic gradients within the bedrock formations range from 0.004 to 0.04 feet per foot with the steeper gradients present near the active landfill. Vertical hydraulic gradients were found to be upward, ranging from 0.05 to 0.62 feet per foot upward, from the Keokuk Formation through the Warsaw Shale to the Salem Formation. Downward vertical hydraulic gradients of between 0.03 and 0.38 feet per foot were observed between wells/piezometers completed in the St. Louis and the Salem Formations. Additional information on the bedrock hydrogeologic conditions can be found in the *Physical Characterization Technical Memorandum for the West Lake Landfill, Operable Unit 2, Bridgeton, Missouri* prepared by Golder Associates, Inc. (1996a).

5.6.2.4 Hydraulic Conductivity and Porosity

Aquifer testing consisting of slug tests was performed on 18 wells located throughout the landfill as part of the OU-1 RI/FS. Slug tests were conducted to assess the hydraulic conductivity of the alluvial materials beneath the landfill. Testing was performed on six shallow alluvial wells (wells completed near the top of the alluvial materials immediately below the landfill materials), six intermediate wells and six deep wells (wells completed near the base of the alluvium near the bedrock contact). The methods used to analyze the slug test results were previously described in Section 4.5.2.4 and are described in detail in the 1996 McLaren/Hart Groundwater Conditions Report.

Results of the aquifer testing indicated that the alluvial materials possess hydraulic conductivity values on the order of 3×10^{-2} centimeters per second (cm/sec) ranging from approximately 9×10^{-4} to 9×10^{-2} cm/sec. Although the amount of available data is limited, these results indicate that the hydraulic conductivity values are slightly greater in the lower portions of the alluvium. A summary of the hydraulic conductivity values obtained from the OU-1 aquifer testing is presented in Table 5-3.

Aquifer testing, consisting of slug tests for alluvial wells and packer tests in bedrock boreholes along with laboratory permeability testing, was also performed as part of the OU-2 RI/FS. Results of the OU-2 slug tests from alluvial wells indicated that the geometric mean of the hydraulic conductivity values obtained from the alluvial materials was 2.9×10^{-3} cm/sec which was approximately one order of magnitude lower than the results of tests performed for OU-1. In addition, the results of the OU-2 testing indicated that the lower hydraulic conductivity values were present in the deeper portions of the alluvial aquifer, on the order of 6×10^{-4} cm/sec. Higher hydraulic conductivity values on the order of 1.5×10^{-2} cm/sec were encountered in the intermediate depth portions of the alluvium. Hydraulic conductivity values on the order of 3×10^{-3} cm/sec were obtained from the OU-2 testing of the shallow alluvial wells.

In general, the results obtained by the OU-2 testing resulted in lower hydraulic conductivity estimates than those obtained based on the OU-1 testing. These differences, although not highly significant given the "order of magnitude" accuracy of slug testing results, potentially result from one or more factors. These factors include the following: differences in testing or data interpretation procedures between OU-1 and OU-2, differences in well drilling and completion techniques, or possibly spatial differences in the hydraulic conductivity of the alluvial aquifer. OU-2 testing was performed primarily in the southern and southwestern portions of the landfill near the active sanitary landfill whereas OU-1 testing was performed primarily in the northern and eastern portions of the landfill in the vicinity of Areas 1 and 2.

No direct measurements of the porosity of the alluvium or the bedrock formations were obtained as part of either the OU-1 and OU-2 efforts owing to the difficulty of performing these types of measurements. Typical total porosity values for unconsolidated sand deposits range from 25 to 50% (Freeze & Cherry, 1972). The effective porosity for groundwater flow cannot be measured directly but for unconsolidated, unconfined aquifers is often approximated as being equivalent to the specific yield. The typical range of specific yield values for unconfined aquifers is from 1 to 30%. As a result, the effective porosity for groundwater flow in the alluvial aquifer is assumed to range from 20 to 30%.

5.6.2.5 Groundwater Flow Directions, Velocity and Flux

Given the overall flat nature of the water table beneath the landfill, exact determinations of the directions of groundwater flow are difficult. Generalized interpretations of the primary direction of groundwater flow can be made based on the water level data obtained from the landfill wells and the location of the landfill relative to the Missouri River and its associated alluvium. Based on these conditions, the general direction of alluvial groundwater flow in the vicinity of the landfill appears to be to the north, parallel to the river valley and the general direction of river flow in this area.

In addition to the general direction of groundwater flow to north, the following influences localized groundwater flow in the alluvium beneath Radiological Areas 1 and 2:

- Dewatering effects associated with the former limestone quarry and the current leachate collection activities,
- Infiltration and localized ponding of storm water on the surface of the landfill,
- Infiltration through various drainage ditches located on and off of the landfill, and
- The water level in the flood control channel located on the western margin of Area 2.

As a result, localized variations to this general direction of groundwater flow do exist beneath the landfill. For example, groundwater flow beneath Area 1 appears to occur primarily in a southern direction toward the active landfill (Figures 5-3, 5-4, 5-5, and 5-6). This flow direction appears to be in response to the pumping associated with the leachate collection system at the active sanitary landfill. Groundwater flow beneath Area 2 is generally to the north-northwest, consistent with the overall regional flow direction.

The velocity of groundwater flow can be estimated using the following equation (Freeze & Cherry, 1979):

$$V = Ki / n_e$$

Where:

V = the velocity of groundwater flow (ft/day);
K = the hydraulic conductivity (ft/day);
i = the hydraulic gradient (ft/ft); and
n_e = the effective porosity (%).

Based on the results of the OU-1 aquifer testing, the average hydraulic conductivity of the alluvium is approximately 3×10^{-2} to 3×10^{-3} cm/sec (85 to 8.5 feet per day). The overall hydraulic gradient within the alluvium ranges from 0.001 to 0.0001 and the effective porosity of the alluvium can be approximated as ranging from 20 to 30%. Therefore, the groundwater flow velocity in the alluvium ranges from a high of approximately 0.4 feet per day to a low of approximately 0.003 feet per day. Using the midpoints of the various ranges results in an estimated average groundwater flow velocity of approximately 0.1 feet per day.

The amount of groundwater flowing beneath the landfill (groundwater flux) can be approximated from the following equation (Freeze & Cherry, 1979):

$$Q = K\,i\,A$$

Where:

Q = the flux of groundwater beneath the landfill (ft^3/day);
K = the hydraulic conductivity (ft/day);
i = the hydraulic gradient (ft/ft); and
A = the saturated cross sectional area (ft^2).

Using the hydraulic conductivity and hydraulic gradient values previously cited and based upon a saturated thickness of approximately 100 feet and a width of approximately 1500 feet, the groundwater flux beneath Areas 1 and 2 is approximately

4,000 ft^3/day (30,000 gallons per day). Using the upper and lower ends of the estimated values for the various parameters results in a range of groundwater flux values of approximately 130 to 13,000 ft^3/day (approximately 1,000 to 100,000 gallons per day).

5.6.3 Water Supply Wells in the Vicinity of the Landfill

No public water supply wells within the vicinity of the landfill obtain any water from the alluvial aquifer (Foth & Van Dyke, 1989). Twenty-six private water supply wells were identified in 1989 within a three-mile radius of the landfill (Foth & Van Dyke, 1989). None of the wells located within a 1-mile radius of the landfill are used as a drinking water source (Foth & Van Dyke, 1994). The distribution of private wells in the vicinity of the landfill is as follows:

- Four wells are located less than one mile from the landfill; however, two no longer exist and the remaining two are not used as drinking water sources. Their uses are discussed below;

- Seventeen wells located between one and two miles from the landfill including four wells used for irrigation purposes, one well at an abandoned site, and twelve wells used as drinking water sources; and

- Five wells located between two and three miles from the landfill, all of which are used as drinking water sources.

The two private groundwater wells within one mile of the landfill are used for monitoring and commercial purposes, and neither is used as a drinking water source (Foth & Van Dyke, 1994). These include the private well located at the Old Bridge Bait Shop that is 5,100 feet northwest from the landfill boundary and a private "shop well" located 4,600 feet northeast from the landfill boundary (Figure 5-7). The nearest well reportedly used as a drinking water source is located approximately 5,300 feet to the north of the landfill (Figure 5-7). The number of private wells has likely decreased since 1989 due to urban and suburban development and flooding of the area in 1993 and 1995.

6.0 NATURE AND EXTENT OF RADIOLOGICALLY IMPACTED MATERIALS

This section summarizes the location, extent and composition of the radiologically impacted materials from which radionuclides have migrated or could potentially migrate from Areas 1 and 2. The procedures used for the characterization of radiologically impacted materials and the use of numerical standards and reference levels are also discussed in this section. Evaluation of the extent of migration or potential migration is presented in Section 7 of this report. Discussion of non-radiological analytical results for the soil samples obtained from Areas 1 and 2 as well as occurrences of non-radiological constituents in the various environmental media at the landfill is presented in Section 8 of this RI report.

6.1 Procedures Used to Characterize Radiologically Impacted Materials

The radiologically impacted materials are present within a matrix of soil and solid waste materials including both sanitary wastes and construction and demolition debris. The solid waste materials contain both radiologically impacted soils and non-impacted soils that cannot be visibly distinguished and both of which are intermixed with solid waste materials. Review of the boring log data and the Soil Boring/Surface Soil Investigation Report (McLaren/Hart, 1996h) indicates that the soils, including those impacted by radiological materials, are interspersed and interlayered within the solid waste and do not occur as discrete units, bodies or definable layers.

As the radiologically impacted materials cannot easily be identified or segregated from either the non-radiologically impacted soils or from the overall matrix of solid waste materials, identification of radiologically impacted materials must rely upon the results of radiological testing of discrete samples, intervals or locations. Specifically, the definition of radiologically impacted materials presented in this RI is based upon the following:

- Results of the overland gamma survey (McLaren/Hart, 1996a);
- Downhole gamma logging of soil borings drilled as part of the RI and re-logging of pre-RI borings (McLaren/Hart, 1996h);
- Results of radiological testing of soil samples obtained from selected depth intervals from the soil borings (McLaren/Hart, 1996h);
- Results of the radiological testing of soil samples performed by RMC (1982); and
- Results of the radon flux measurements (EMSI, 1997c).

Figure 6-1 summarizes the approximate extent of radionuclides exposed at the surface in Areas 1 and 2 based upon the following:

- Concentrations of radionuclides above surface reference levels (see discussion in Section 6.3 below);
- Down-hole gamma logs with elevated levels and definable peaks;
- Results of the overland gamma survey; and
- Results of the radon flux measurements.

Figure 6-2 summarizes the approximate extent of radionuclides in the subsurface in Areas 1 and 2 based on concentrations of radionuclides above subsurface reference levels, results of the downhole gamma logging, the overland gamma survey results, and radon flux measurements.

Tables 6-1 through 6-4 summarize the range of radionuclides found in the source materials from Area 1 and Area 2 and provide an indication of the frequency that individual radionuclides exceed background and reference levels. These tables summarize the following information:

- Calculated background and reference values;
- The number of borings with samples containing radiological levels above background levels but below the reference levels; and
- The number of borings with samples containing radiological levels above the reference levels for surface soils in Area 1 (Table 6-1), subsurface soils in Area 1 (Table 6-2), surface soils in Area 2 (Table 6-3) and subsurface soils in Area 2 (Table 6-4).

Complete summaries of the soil sample radiological and non-radiological analyses are presented in Appendix B.

6.2 Background Levels of Radionuclides

Tables 6-1 through 6-4 also include information on background levels of radionuclides in the area soils. McLaren/Hart calculated background levels from values measured at four background sampling locations (Table 6-5). Two of these locations were between 1,200 and 1,500 feet south of the southeastern corner of the landfill in the borrow area for the existing active landfill. One sample was collected from an unimpacted area on the Ford property west of the landfill. The final sample was collected north of the landfill on the northeastern side of St. Charles Rock Road.

Table 6-6 presents a comparison of the background values obtained by McLaren/Hart for the West Lake RI to background values obtained from other investigations in this general area. The results obtained by McLaren/Hart compare well with the results obtained by these other studies.

These background values are included on the various tables and summaries presented in the RI. As described below, the background values obtained by McLaren/Hart from the area around the landfill have been used in the calculation of the reference levels in accordance with the procedures set forth in 40 CFR 192.

6.3 Use of Numerical Standards and Reference Levels

Contamination is typically defined by comparing sampling results to background results. This type of analysis identifies any samples containing site-related constituents as contaminated or impacted. This type of evaluation is presented in this section of the RI report. However, as discussed later in the text, one of the problems with this approach is that the extent of contamination can be significantly affected by one or a few sample results that although above background levels and therefore determined to be contaminated, may only be slightly greater than background. Strict application of background values to define contamination from radionuclides is even further complicated by the counting errors associated with radionuclide results. For example, although a particular sample may be reported as having an activity level that is 0.1 pCi/g greater than the background level, this sample may have a counting error associated with its result of ± 0.3 pCi/g. Therefore, although the reported sample result is technically greater than the background level, there is an uncertainty factor associated with such a value that could result in the actual value being at or possibly below the background level. The counting error varies with each sample analysis and therefore there is not a single value that could be used for all of the results, or even for all of the results for a particular radionuclide.

The presence of results that are only slightly above background at the margins of a site or possibly as random occurrences of such results throughout a site greatly complicates identification of the lateral extent of contamination. Definition of contamination based strictly on a comparison to background alone can result in overestimation of the actual extent of contamination thereby potentially resulting in a false impression of potential impacts and/or possible elimination of some potential remedial technologies that may otherwise be considered. The presence of radiological or chemical constituents at levels greater than background does not necessarily represent a risk to public health or the environment. Potential risks associated with elevated levels of site-related constituents are evaluated as part of the Baseline Risk Assessment.

As part of various improvements to the Superfund program, EPA has developed presumptive remedy approaches for several of the more common types of Superfund sites including municipal solid waste landfills. EPA's RI/FS Guidance for Municipal Solid Waste Landfills indicates that the primary focus of the RI/FS effort at municipal solid waste landfills should not be focused on large volumes of low levels of contamination but should focus on identifying smaller areas with higher levels of contamination. Consequently, for purposes of Operable Unit (OU) –1, a simple set of numerical levels that have been commonly used at other sites with radiological constituents were identified as a means of describing the extent of higher levels of radionuclide occurrences. These numerical levels are termed "reference levels" and are used in the RI to segregate areas with negligible levels of radionuclides from those that are clearly greater than background.

The discussions regarding the locations and extent of the radiologically impacted materials presented in this RI are based in part on the concept of "reference levels". Reference levels have been derived for OU-1 based upon the EPA "Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings" as set forth in Title 40, Part 192, Sections 12 and 41. These standards state that:

> The concentration of radium-226 (or radium-228) in land averaged over any area of 100 square meters shall not exceed the background level by more than - (1) 5 pCi/g, averaged over the first 15 cm of soil below the surface, and (2) 15 pCi/g, averaged over 15 cm thick layers of soil more than 15 cm below the surface.

These standards are only directly applicable to uranium and thorium mill tailings sites. These standards are also applied only to areas that have a potential for unrestricted (i.e., residential) use. The landfill area has been and currently is a landfill with industrial uses that are subject to a deed restriction that prevents residential uses.

No other numerical standards have been established that could assist in characterizing the potential extent of radiologically impacted materials at the West Lake Landfill. In the absence of any other established standards, values based upon the standards promulgated by EPA under 40 CFR 192 are included in the RI evaluations. These reference levels have been included in the RI solely as a point of reference and are only included for use in evaluating the site investigation data and characterizing the locations and potential extent of the radiologically impacted materials.

Although the EPA standards only directly address radium-226 and radium-228 and indirectly thorium isotopes, these standards have also been applied to the other radionuclides and have been utilized in the tables in this section to assist in the evaluation and summary of the occurrences of the other radionuclides detected in both Area 1 and Area 2. Specifically, reference levels for occurrences of other radionuclides (other than radium-226 or radium-228) in surface soils have been developed based upon background levels of radionuclides plus 5 picocuries per gram (pCi/g). Similarly, subsurface reference levels have been developed for other radionuclides based upon background levels plus 15 pCi/g in accordance with the procedures set forth in 40 CFR 192. Risk-based levels that are considered to be protective of human health and the environment from radionuclide occurrences at the landfill will be developed as part of the Feasibility Study (FS) based upon the results of the Baseline Risk Assessment (BRA).

As discussed above, reference levels have been used in the following discussions and associated evaluations to assist in defining the potential sources and extent of the possible source of the radiological materials. Use of reference levels is not and should not be construed to indicate that radionuclide occurrences at concentrations below the reference levels but above background do not represent contamination. Occurrences of radionuclides at levels below the reference levels but above background clearly represent potential contamination although not necessarily a risk to human health or the environment; however, as the sample concentrations approach the background levels, it becomes less relevant to the selection of a presumptive remedy.

The use of reference levels in the RI to assist in identifying the occurrence and assessing the potential extent of radiological materials should also not be construed as representing selection of the 40 CFR 192 standards as ARARs or their selection as actual or potential remediation standards. Remediation standards will be selected as part of the development of a "Proposed Plan" and Record of Decision.

As required by the National Contingency Plan (NCP), EPA's remedy selection will be based upon nine criteria. Two of these criteria, protection of public health and the environment and compliance with ARARs, are considered to be threshold criteria that generally must both be met by any remedy that is selected. Evaluation of the degree of protectiveness of any remedial alternative that may be considered will include not only a comparison to potential ARARs but also an evaluation of the potential exposures and associated risks. Calculation of potential exposures and associated risks has been performed as part of the Baseline Risk Assessment (BRA) presented in Appendix A. Results of the BRA will be used in the Feasibility Study (FS) to develop remedial action objectives and preliminary remediation goals in accordance with the procedures set forth in appropriate EPA guidance. Such guidance will include, but is not necessarily limited to, the Office of Solid Waste and Emergency Response (OSWER) Guidance No. 9200.4-18 regarding "Establishment of cleanup levels for CERCLA sites with radioactive contamination."

As described previously in Section 4.7, EMSI obtained radon flux measurements at 54 locations in Areas 1 and 2 in June 1997. Results of these measurements of radon flux levels were compared to the 20 pCi/m^2s standard for radon emissions from the disposal of uranium mill tailings promulgated in 40 CFR Part 61. Similar to the previous discussion of the reference levels, this radon flux standard is only strictly applicable to uranium mill tailings sites. As previously indicated, an evaluation of potential ARARs has not yet been completed for the landfill. Although the EPA standard for radon flux is only applicable to uranium mill tailings, it may be considered a potential ARAR for the

West Lake Landfill. Therefore, this standard has been included in this report to assist in the evaluation of the significance of the radon flux measurement results.

In summary, reference levels and numerical standards are only presented and used in the RI as a means of easily and consistently identifying those materials that have been impacted by radionuclides and providing an initial assessment of their extent. Final determination of the extent of radiologically impacted materials that may require remediation along with identification of the appropriate standards or health-based criteria to be considered in selecting a remedy for OU-1 will be made as part of the Proposed Plan and Record of Decision.

6.4 Radiologically Impacted Materials in Area 1

The boundaries of Area 1 have been defined based on the results of the overland gamma survey, the down-hole radiological logging effort, collection and analysis of soil samples from various soils borings, and the results of the radon flux measurements. The radiological activity defined by the soil borings logs, downhole gamma logging results and soil sample analyses generally coincides with the boundaries of the area of elevated overland gamma readings identified by the overland gamma survey results from Area 1. This can be observed by comparing Figures 4-4 through 4-8 to Figures 6-1 and 6-2. The following sections describe the occurrence and potential extent of radiologically impacted materials present at the ground surface and the occurrence and potential extent of radiologically impacted materials in the subsurface in Area 1.

6.4.1 Radiologically Impacted Materials at the Surface in Area 1

Only two of the nine surface samples collected in Area 1 contained radionuclides with activities above the reference levels (Figure 6-3). These two samples were obtained from borings WL-106 and WL-114. It should be noted that the analytical results from the soil samples from boring WL-114 indicated that, although the surface sample contained levels of radionuclides above the surface reference levels, the down-hole gamma log indicated that the highest gamma activity occurred at a depth of 4 to 5 feet. Boring WL-114 was thus included within the boundaries of both the surface and the subsurface areas of affected materials.

The approximate region in Area 1 containing locations with surface soil sample analytical results above surface reference levels, down-hole radiological logs with elevated downhole gamma readings at or near the surface, and elevated overland gamma results is shown on Figure 6-3. This area includes approximately 51,000 square feet. Based upon a 6-inch depth interval consistent with the definition of surface materials in the EPA uranium and thorium mill tailing standards discussed above, the volume of impacted surface materials in Area 1 is estimated to be approximately 940 cubic yards (yd^3).

In addition to boring locations WL-106 and WL-114, which exceeded reference levels, three other locations contained levels of radionuclides above background levels but below reference levels. These three locations were WL-112, WL-121 and WL-123. The sample obtained from location WL-112 contained thorium-230, radium-226 and lead-214 at levels only slightly greater than background. The sample obtained at location WL-121 only contained lead-214 at a level slightly above background and the sample at WL-123 only contained uranium-234 and lead-214 at levels slightly above background. Soil sampling locations that displayed radionuclide levels greater than background are shown on Figure 6-3. As can be seen on this figure, the samples obtained from WL-121 and WL-123 that contained radionuclides above background levels are separated from the area of higher levels of radionulcides by surface soil samples (WL-116 and WL-124) in which elevated levels of radionulcides were not detected.

Results of the radon flux measurements indicated that two sample locations in Area 1 displayed radon flux levels above the 20 pCi/m^2s standard. These samples were obtained adjacent to boring locations WL-102 and WL-106 (Figure 4-14). Both of these locations are inside of the boundary of surface occurrences of radiologically impacted materials (Figure 6-3) defined based on the surface soil sample analyses, overland gamma survey and down-hole gamma logging results. Consequently, consideration of the radon flux results does not necessitate any changes to the boundary of the surface extent of radiologically impacted materials in Area 1 shown on Figure 6-3.

The previous investigation of Area 1 (RMC, 1982) identified two locations with surface soils containing radionuclides above the reference levels. Both of these samples were located due east of the Bridgeton Landfill office building and are included within the area of surface soils above reference levels presented on Figure 6-3. As a result, consideration of the historic investigation results obtained by RMC does not necessitate any adjustment to the extent of surface soils greater than reference levels in Area 1.

6.4.2 Radiologically Impacted Materials in the Subsurface of Area 1

Figure 6-4 shows the approximate region of the subsurface occurrence of radiologically impacted materials in Area 1. This area was delineated based on the subsurface soil sample analytical results that included radionuclides above the subsurface reference levels or the results of down-hole radiological logging that showed elevated gamma readings, or both.

A total of four RI borings (WL-105, WL-106, WL-114, and WL-118) contained radionuclides at concentrations greater than the reference levels. Two additional borings, WL-112 (sample from 5-ft depth) and WL-117 (sample from 10-ft depth), contained samples with levels of thorium-230 above reference levels. In addition, thorium-230 was the only radionuclide exceeding reference levels in the sample obtained from the 5-ft depth from boring WL-114. Although the levels of the other radionuclides in these three samples were less than the reference levels, they generally did exceed background levels; therefore, these samples and borings were also assumed to represent areas exceeding the reference levels.

A total of 31 borings in Area 1 were downhole gamma logged (Table 6-7). These included 20 RI soil borings, two RI borings drilled as part of the monitoring well construction effort, and nine of the existing poly-vinyl chloride (PVC) cased borings drilled by RMC that were re-logged by McLaren/Hart (1996h) as part of the RI effort. A total of ten RI borings displayed elevated downhole gamma levels. In addition, five of the PVC cased borings also displayed elevated downhole gamma readings. Of the fifteen borings with elevated gamma levels, eight displayed very well defined peaks and seven displayed only poorly defined peaks. A value of approximately 1,300,000 counts per minute (cpm) was the highest downhole gamma reading observed in the Area 1 borings. This value was measured at the 10-foot depth in boring PVC-38. Several borings displayed values between 100,000 and 400,000 cpm. Ten of the fifteen borings that displayed definable gamma peaks had measured gamma values of less than 100,000 cpm and over half of these contain values of less than 20,000 cpm.

The borings with subsurface samples containing radionuclides above the subsurface reference levels and/or elevated downhole gamma readings in Area 1 are displayed on Figure 6-4. The areal extent of subsurface occurrences of radiologically impacted materials in Area 1 includes approximately 194,000 square feet. The two locations with the radon flux measurements exceeding 20 pCi/m^2s (adjacent to borings WL-102 and WL-106) are located within the extent of subsurface occurrences of radiologically impacted materials as shown on Figure 6-4. Therefore, incorporation of the radon data does not change the extent of the subsurface occurrences of radiologically impacted materials.

Radiologically impacted materials were found to be present in the subsurface of Area 1 at two different depths. In the northwestern part of Area 1, radiologically impacted materials were identified at depths generally ranging between 0 and approximately 6 feet. In the southeastern portion of Area 1, radiologically impacted materials occur at a somewhat deeper interval ranging from 0 to approximately 15 feet (Table 6-7).

One location in Area 1 contains three borings (WL-105, well S-5, and well I-4) in close proximity that were all downhole logged for gamma radiation. Although the existing ground surface elevation of these three borings was quite close (467.2, 465.7, and 466 feet above mean sea level respectively) the depths to the gamma peak in each of these borings varied significantly. Depths of the gamma peaks and corresponding elevations ranged from 9-ft (elevation 458.2-ft) in WL-105 to 3.5-ft (elevation 462.2-ft) in well S-5 to 6.5-ft (elevation 459.5-ft) in well I-4. These data suggest that the depth and elevation at which the radiologically impacted materials occur varies highly over even small distances indicating that the horizon(s) in which the radiologically impacted materials occur are highly variable and highly irregular.

An average thickness of 3.3 feet was derived for these materials from the ten RI borings and the five pre-RI borings containing intervals with elevated down-hole gamma readings (Table 6-8). Based upon the areal extent of the subsurface materials greater than reference levels (194,000 ft^2) and an estimated average thickness of 3.3 ft, the volume of potential source materials is estimated at approximately 24,000 cubic yards. This volume includes both the impacted soil and the associated refuse, debris, and fill materials.

In addition to the area of subsurface soils containing radionuclides above reference levels, occurrences of radionuclides below reference levels but above background were detected in subsurface soil samples obtained from three locations to the northeast and south of the eastern portion of the area containing higher levels of radionuclides (Figure 6-4). These three locations include borings WL-103, WL-104 and WL-111 all of which contained thorium-230 at levels slightly greater than background. No other radionuclides were detected at levels above background in the subsurface soil sample obtained from these three locations. Subsurface soil samples obtained from two other locations also contained radionuclides above background levels; WL-109 contained radium-226 and lead-214 at levels slightly above background and WL-110 contained lead -214 at a level slightly above background.

6.4.3 Correlation of Radionuclide Occurrences in Area 1

The results of the analyses for soil samples obtained from Area 1 (Tables B-1, B-3 and B-5 in Appendix B) were reviewed to assess the degree to which radionuclide occurrences are co-located with each other. Thorium-230 was the radionuclide generally detected at the highest levels. Review of the analytical results for other isotopes in the U-238 decay series indicates that in general the samples containing thorium-230 above the reference level generally also exceeded the reference levels or at a minimum generally exceeded background for uranium-238, radium-226, lead-214, bismuth-214 and lead-210. Those samples that only contained radionuclides above background but below reference levels generally only contained one or two radionulcides at levels slightly above background. Therefore, where higher levels of radionuclides are present there generally is a good correlation between the occurrences of elevated levels of the various radionuclides. Where the detected levels are only slightly greater than background, there generally is a much poorer correlation between occurrences of the various radionuclides.

6.5 Radiologically Impacted Materials in Area 2

The boundaries of Area 2 have been defined based on the results of the overland gamma survey, the down-hole radiological logging effort and the collection and analysis of soil samples from various soils borings. The radiological activity defined by the soil borings, borehole logging, and soil sample analysis program is generally within the extent of the area of elevated gamma readings as defined by the results of the overland gamma survey for Area 2.

6.5.1 Radiologically Impacted Materials at the Surface of Area 2

Only two of the 15 surface soil samples (ten from drilled borings and five from hand auger borings) displayed radionuclide levels significantly above the reference levels (Figure 6-5). These locations include the surface samples obtained at the locations of soil borings WL-209 and WL-210. In addition to these two locations, the surface sample from hand auger boring WL-243 displayed levels of thorium-230, lead-210 and protactinium-231 above surface reference levels. Only the thorium-230 value from this hand-auger boring was substantially above the surface reference level.

Five additional surface soil locations (soil borings WL-213, WL-222, and WL-235 and hand auger borings WL-242 and WL-244) displayed levels of thorium-230 above the surface reference levels. Given the potential thorium data quality issues discussed in Section 4 of this report, the representativeness of the thorium-230 results for each of these samples was further evaluated. Discussions of each of these samples are presented in the following paragraphs.

Thorium-230 was detected at 131 pCi/g in the surface sample from boring WL-222. Although the levels of the other radionuclides detected in the surface sample from boring WL-222 were at or only slightly greater than background, the thorium-230 level in this sample was substantially greater than background. In addition, elevated gamma readings were detected in the area of this boring during the overland gamma survey. Therefore, this sample was considered to represent a surficial occurrence of radiologically impacted materials.

In the case of the surface samples from borings WL-213 and WL-235, the thorium levels were only slightly greater than background. In addition, the other radionuclides detected in these samples were all present at levels less than background. Therefore, the representativeness of the thorium-230 results from these two samples is potentially questionable. Boring WL-213 lies at the edge of an area containing elevated gamma levels as defined by the overland gamma survey. In order to maintain a conservative estimate of the potential extent of radiologically impacted materials, this sample was considered representative of a surficial occurrence of radiologically impacted materials. Boring WL-235 lies in an area where only background gamma levels were identified during the overland gamma survey. There are no other data or information indicating the presence of radiologically impacted materials in the vicinity of this boring; however, in order to develop a conservative estimate of the extent of radiologically impacted materials, this sample was considered to represent a surficial occurrence of radiologically impacted materials.

The area defined by hand borings WL-242, WL-243 and WL-244 was defined separately from the boundaries of the area of surface materials exceeding reference standards. This was done because the area near these samples appears to be associated with deposition of runoff sediments rather than surface exposure of in-place material.

The radon flux measurement activities completed by EMSI in June 1997 indicated that only two sample locations in Area 2 had measured flux levels above the 20 pCi/m^2s standard for radon emissions for uranium and thorium mill tailings (WL-209 and WL-223, see Figure 6-5). As the surface sample obtained from boring WL-209 exceeded reference levels, no modification to the surficial extent of radiologically impacted materials was necessary. Based upon the radon flux reading from boring WL-223 and the presence of thorium-230 above background at the 5-ft depth in this boring (a surface sample was not obtained from this location), the boundary for surface exposure of radionuclides was drawn to include the area around boring WL-223.

RMC obtained approximately seven surface soil samples and nine surface samples from auger borings that contained radionuclides above the reference levels. Consideration of the surface soil samples obtained by RMC or the surface samples obtained from the soil borings drilled by RMC during their investigation did not result in any changes to the extent of surface occurrences of radiologically impacted material in Area 2.

The approximate region in Area 2 containing surface soils with radionuclide concentrations above the surface reference levels, downhole gamma logs with elevated gamma levels at or near the surface, or locations with radon flux emissions above 20 pCi/m^2s is shown on Figure 6-5. This area is approximately 469,000 square feet. Based upon a 6 inch depth, consistent with the definition of surface materials in the EPA uranium and thorium mill tailings standards discussed above, the volume of radiologically impacted materials at the surface of Area 2 is estimated to be approximately 8,700 cubic yards.

In addition to the samples containing radionuclides above reference levels, several locations were identified in the northern and northeastern portion of Area 2 that contained surface soil with radionuclides above background but below reference levels. These include the surface soil samples from WL-215, which only displayed thorium-230 above background, WL-231 which contained uranium-234 at a level just slightly greater than background and WL-245 and WL-246 both of which contained only thorium-230 at levels just slightly greater than background. Soil sampling locations with radionuclides occurrences above background levels are shown on Figure 6-5.

6.5.2 Radiologically Impacted Materials in the Subsurface of Area 2

Figure 6-6 displays the locations of the borings with subsurface samples that contained radionuclides above subsurface reference levels in Area 2. A total of four of the 45 soil borings in Area 2 had subsurface samples that contained radionuclide levels significantly above the reference levels. These borings include WL-209, WL-210, WL-216, and WL-234.

Radionuclides were detected above reference levels in two other borings (WL-211 and WL-241). In both of these borings only thorium-230 and lead-210 exceed reference levels. Other radionuclides, although not greater than reference levels in these samples, did exceed background levels. Therefore, these two borings were considered to represent subsurface occurrences of radiologically impacted materials.

Subsurface samples from ten borings reportedly contained only thorium-230 above the subsurface reference levels. These locations included WL-208, WL-212, WL-214, WL-222, WL-226, WL-227, WL-230, WL-231, WL-233, and WL-242 (hand-auger boring sample from 2 feet). Thorium-230 was detected at concentrations greater than 100 pCi/g in borings WL-208, WL-212, WL-226, and WL-233. In addition, although the other radionuclides detected in these borings did not exceed reference levels, they generally were detected above background levels. Consequently, these borings were included in the identification of the subsurface extent of radiologically impacted materials. Samples from borings WL-222, WL-227, WL-230, WL-231 and WL-242 contained thorium-230 at levels ranging from 20 to 95 pCi/g. Many of the other U-238 decay series radionuclides were detected at levels above background (although generally only slightly above) in these samples. Therefore, these samples were also considered in the evaluation of the subsurface extent of radiologically impacted materials. The only sample with an elevated throium-230 level (44.4 pCi/g) that displayed only background levels of the other radionuclides was the sample from the 5-foot depth from boring WL-214. Downhole gamma levels measured in this boring were not elevated. As a result the thorium-230 result from this boring may be questionable; however, in keeping with a conservative approach, this location was also included within the evaluation of the subsurface extent of radiologically impacted materials in Area 2. In summary, all of the samples containing one or more radionuclides above reference levels, including all of those for which only thorium-230 exceeded reference levels, were included in the development of the boundary defining the extent of subsurface radiologically-affected materials.

A total of 51 borings in Area 2 were downhole gamma logged including thirty-three RI borings and eighteen PVC cased borings remaining from the earlier RMC investigation (Table 6-9). Twenty-two of these borings did not display definable gamma peaks while twenty-nine did (Table 6-9). The highest observed downhole gamma reading, nearly 2,300,000-cpm, was measured at the 3-foot depth of PVC-11, which is located in the southern portion of Area 2. High downhole gamma levels were also measured at the 7-foot depth in boring WL-234 (1,100,000 cpm) which is located in the same general area as PVC-11. Very high readings were also detected at the 2-foot depth in PVC-7 (approximately 1,400,000 cpm) and PVC-4 (approximately 1,300,000 cpm) both of which are located in the same general area in the northern portion of Area 2. Eleven other borings in Area 2 displayed downhole gamma levels between 100,000 and

800,000 cpm. The remaining thirteen borings with definable peaks displayed values of less than 100,000 cpm with most of these less than 25,000 cpm.

Twenty borings displayed identifiable gamma log peaks at shallow depths of five feet or less. Of these, thirteen of the logs displayed very well defined peaks and seven displayed poorly defined peaks with intensities of 24,000 counts per minute (cpm) or less. Three borings displayed peaks at slightly greater depths ranging between 7 and 11 feet and one boring (WL-233) displayed a peak at a depth of 22-feet. Four borings displayed two separate peak intervals at depths ranging from 2.5 to 9-feet for the first peak and 7 to 11-feet for the second peak. One boring, WL-235, only displayed a peak at the bottom of the hole.

Boring WL-210 was re-logged because during the first logging attempt material was knocked into the hole resulting in a small poorly defined peak at the bottom of the hole in addition to the well-defined peak identified at the ground surface. The material present in the bottom of this hole was removed and the subsequent logging effort did not indicate a peak at the bottom of this boring. Two other borings (WL-235 and PVC-7) also contained poorly defined peaks at the bottom of the hole that may also be the result of radiologically impacted material present at shallower depths having been knocked into the hole during the drilling or logging activities.

Based upon the results of the downhole gamma logging and the laboratory analyses, radiologically impacted materials were generally found at depths ranging between 0 to approximately 6 feet in the northern portion of Area 2. These depths correspond to elevations of approximately 457 to 462 feet above mean seal level. Deeper occurrences of radiologically impacted materials were identified in a few borings in the northern portion of Area 2. The sample obtained from the 20-foot depth in boring WL-226 contained 173-pCi/g thorium-230 along with other radionuclides above background levels. This boring also displayed a downhole gamma peak at the 11-foot depth. Borings PVC-5, PVC-6, and PVC-7 displayed two separate gamma peaks with the lower peaks occurring at depths of 11 to 19.5 feet (Table 6-10). Elevated downhole gamma readings were detected at a depth of 8-feet in boring PVC-19. A second interval of elevated downhole gamma readings was measured at a depth of 7-feet in boring PVC-40. The sample from the 25-foot depth in WL-209 displayed a thorium-230 concentration (26.9 pCi/g) greater than the subsurface reference level (17.45 pCi/g); however, analysis of the field duplicate sample from this same location and depth did not contain thorium-230 above the subsurface reference level (12.85 pCi/g).

In the southern part of Area 2, radiologically impacted materials were identified at depths generally ranging between 0 and 6 feet. Deeper occurrences of radiologically impacted materials, specifically thorium-230 levels above the reference level, were also identified in boring WL-233 in the southernmost portion of Area 2 where thorium-230 was detected at the 27-ft depth at 427 pCi/g. Elevated downhole gamma readings were identified at a depth of 22-feet in this boring. Several radionuclides of the uranium-238 decay series were detected at concentrations greater than their reference levels in the sample from the 10-foot depth from boring WL-234. A second interval of elevated gamma readings was identified at the 10-foot depth in boring PVC-10.

Elevated downhole gamma readings were also measured in the bottom of boring WL-235 at a depth of 22.5 feet. This reading may possibly be the result of radiologically impacted material having been knocked into or down the hole during drilling or logging. However, neither the downhole gamma logging or the analyses of the soil samples indicated the presence of materials above the subsurface reference levels at any other depth in this boring. Boring WL-235 is located in the same general area as boring WL-233 that displayed indications of radiologically impacted materials at depth. The sample from the 40-foot depth in WL-210 also displayed a thorium-230 concentration (18.2 pCi/g) greater than the reference level (17.45 pCi/g); however, analysis of the field duplicate sample from this same location and depth did not contain thorium-230 above the subsurface reference level (10.8 pCi/g).

The two locations with radon flux measurements above 20 pCi/m^{2}s were WL-209 and WL-223 in Area 2 (Figure 6-6). As these locations were within the boundary of the subsurface occurrence of radiologically impacted materials in Area 2, incorporation of the radon flux data does not change the subsurface extent of radiologically impacted materials in Area 2.

The approximate extent of that portion of Area 2 with either subsurface soil sample analytical results above subsurface reference levels or downhole radiological logs with elevated gamma readings is shown on Figure 6-6. This area includes approximately 817,000 square feet. An average thickness of 3.6 feet was derived for these materials from the twenty-nine borings containing intervals with elevated down-hole gamma readings as shown on Figure 6-6. Based upon the estimated areal extent and an average thickness, the volume of potential subsurface source materials is estimated at approximately 109,000 cubic yards. This volume includes both the impacted soil and the associated refuse, debris, and fill materials.

Numerous other borings contained samples with radionuclide occurrences that were above background levels below the reference levels. These locations are shown on Figure 6-6. In general, most of the occurrences of subsurface samples containing radionuclides above background but below reference levels were identified based on occurrences of thorium-230 and to a lesser extent lead-214.

Two of the locations where radionuclide occurrences above background were reported may not actually be representative of contamination. The only occurrence of radionuclides above background detected at WL-218 was in the sample obtained from a depth of 40 feet, which reportedly contained thorium-230 above background. Neither this nor any other radionuclides were detected in the surface or 5-foot sample obtained from this location and there was no indication of elevated downhole gamma readings identified in this boring. The only occurrence of radionuclides above background in the subsurface at WL-207 was a reported detection of thorium-232 slightly greater than background in the duplicate of the five-foot depth sample obtained from this location; however, the level of throium-232 in the original sample from this depth was below background.

6.5.3 Correlation of Radionuclide Occurrences in Area 2

The results of the analyses for soil samples obtained from Area 2 (Tables B-2, B-4 and B-6 in Appendix B) were reviewed to assess the degree to which radionuclide occurrences are co-located with each other. Thorium-230 was the radionuclide generally detected at the highest levels. Review of the analytical results for other isotopes in the U-238 decay series indicates that in general the samples containing thorium-230 above the reference level generally also exceeded the reference levels or at a minimum generally exceeded background for uranium-238, radium-226, lead-214, bismuth-214 and lead-210. Those samples that only contained radionuclides above background but below reference levels generally only contained one or two radionuclides at levels slightly above background. Therefore, where higher levels of radionuclides are present there generally is a good correlation between the occurrences of elevated levels of the various radionuclides. Where the detected levels are only slightly greater than background, there generally is a much poorer correlation between occurrences of the various radionuclides.

6.6 Radiological Occurrences in the Northeastern Portion of Area 2

As previously indicated, there is a small area in the northeastern portion of Area 2 where radionuclides were detected at concentrations greater than the reference levels. Specifically, this included the area around hand-auger borings WL-242, WL-243 and WL-244. This area was defined separately from the other occurrences of surface materials exceeding reference standards in Area 2 because the area in the vicinity of these samples appears to be associated with deposition of runoff sediments rather than surface exposure of in-place material.

The areal extent of the impacted surficial materials present in the northeastern portion of Area 2 is estimated to be approximately 17,000 square feet or approximately 0.4 acres. Based on a estimated six-inch thickness for this material, the estimated volume of impacted soil present in this area is approximately 320 cubic yards.

6.7 Distribution of Radiologically Impacted Materials in Areas 1 and 2

As previously discussed, the radiologically impacted materials present in Areas 1 and 2 are distributed throughout an overall matrix of solid waste materials including sanitary (household) wastes and construction and demolition debris. Based upon observations of the cuttings materials brought to the ground surface during the boring program, extensive discrete layers of soil, whether impacted or otherwise, were not identified. Instead, the boring logs indicated that although some of the radiological impacted materials are present at or near the surface of the landfill, a large portion of the radiologically impacted materials are present in the subsurface and occur in an interlayered and interspersed manner among the solid waste materials.

Table 6-11 presents a summary of the occurrences of elevated gamma levels based upon the downhole gamma logging results, the soil sample intervals and radiological analyses and the boring log descriptions of the materials encountered at each of these intervals. As can be seen from the information presented on this table, occurrences of elevated downhole gamma readings as well as occurrences of radionuclides above reference levels or, even above background, were associated with a wide variety of solid waste materials containing varying amounts of soil.

Review of the boring log information does not indicate the presence of any distinct or definable soil layers, whether radiologically impacted or otherwise, within the landfill matrix. Based upon the information presented in this section, it is EMSI's opinion that the sources of the radiological occurrences are dispersed within the volume of landfill materials described above for Areas 1 and 2.

6.8 Radiologically Impacted Materials at the Ford Property

Borings WL-201 through WL-206 were advanced by McLaren/Hart to characterize the Ford property northwest of Area 2. Eight additional locations were sampled by EMSI during May 1997 (locations FP-1 through FP-8 on Figure 6-7).

The analytical results for the samples obtained from the Ford property are summarized in Appendix B. These data indicate that thorium-230, radium-226, lead-214, bismuth-214, lead-210, protactinium-231, actinium-227, radium-223, and thorium-232 are all present in the surface sample from WL-206 at activities above the surface reference levels. The analytical results obtained by McLaren/Hart (1996h) from the surface sample from boring WL-206 are consistent with the results obtained by EMSI as part of the subsequent sampling activities (EMSI, 1997a, 1997d). Thorium-230 is present above the reference level in the surface samples obtained by EMSI from locations FP-1, FP-5 and FP-8 (EMSI, 1997d). Radium-226 is present in the surface sample from FP-4 above the reference level. None of the samples collected from the Ford property by either McLaren/Hart (1996h) or EMSI (1997d) from depths of 6 inches or more below the ground surface contain any radionuclides with activities above the reference levels.

Figure 6-7 shows the assumed extent of materials containing radionuclides on the Ford property. Based upon an areal extent of 196,000 square feet and an assumed maximum depth of 6 inches, the volume of affected soil on the Ford property is estimated at approximately 3,600 cubic yards.

In addition to occurrences of radionuclides above reference levels in the surface soil on the buffer zone and Lot 2A2 of the Crossroad property, three other surface soil samples (WL-203, FP-2 and FP-7) contained radionuclides above background levels. The potential extent of surface soil containing radionuclide occurrences above background is shown on Figure 6-7. Although none of the subsurface samples obtained from the buffer zone and Crossroad property contained radionuclides above reference levels, several samples did exceed background levels. The extent of these occurrences is shown on Figure 6-8 and generally coincides with the extent of radionuclide occurrences above reference levels reported in the surface samples.

During a site walkover conducted on November 18, 1999, Herst & Associates observed that the upper 2 to 6-inches of soil material had been scraped from Lot 2A2 and the buffer property and pushed up against the boundary fence separating the buffer zone and Crossroad properties from the West Lake Landfill (Figure 6-9). A minor amount of scraped material was also mounded along the northern portion of the buffer zone and Crossroad properties. Approximately 10 to 12 inches of gravel had been placed over the eastern portion of the Property (Lot 2A1 and a small component of Lot 2A2), while the remaining disturbed soils were left exposed. The dates during which the excavation occurred are not known.

EMSI prepared an Interim Measures Work Plan (EMSI, 1999) and submitted this work plan to EPA. Activities addressed by the work plan included among other things, consolidation of the soil piles located along the edge of the buffer zone and Crossroads properties onto the surface of Area 2 and collection of additional surface soil samples from the buffer zone and Lot 2A2 to assess the current conditions of these properties.

The additional sampling was conducted by Herst & Associates on behalf of EMSI on February 14, 2000. Seven additional surface soil samples were collected including two from the buffer zone and five from Lot 2A2 (Figure 6-10). These samples were analyzed for radioisotopes (Table 6-13). Review of the analytical results for these samples indicates that only one sample (RC-02) contained radionuclides above reference levels. This sample contained thorium-230 at a level of 30.6 pCi/g. This sample also contained lead-210 at a level below the reference level but above background for this constituent. This sample was collected near well D-6 (soil boring WL-206) where radionuclides had previously been detected. All of the other samples contained thorium-230 at levels below the reference level but above background. Sample RC-07 also contained thorium-228 and thorium-232 at levels very near to but slightly above background. Other than the thorium isotopes and the one detection of lead-210, none of the other radionuclides (i.e., uranium or radium isotopes) were detected at levels above background. Based on these results, the majority of radiologically impacted soil that had previously been present on the former Ford property (now the buffer zone and Crossroad Lot 2A2) was removed from the surface and placed in the soil piles.

6.9 Summary of Radiologically Impacted Material Occurrences

Based upon the results of the previous discussions, four distinct areas of radiologically impacted materials have been identified. These include both Areas 1 and 2 where radiologically impacted materials are present both at the surface and in the subsurface. They also include surficial materials transported by erosional processes in the northeastern portion of Area 2, and surficial materials present in the southern portion of the Ford property as a result of erosional transport along the landfill berm at the northern boundary of Area 2.

A summary of the estimated areal extent and estimated volume of each of these occurrences of radiologically impacted materials is presented on Table 6-12. Due to the interspersed nature of the radiological materials within the overall matrix of solid waste, the estimated volumes of radiologically impacted materials include not only the soil or other materials containing radionuclides, but also unimpacted soils and solid waste materials in which the impacted soil is contained. Based upon the estimated extents and volumes of each of these occurrences as described above and summarized in Table 6-12. the total areal extent of impacted materials (both surface and subsurface) is approximately 28 acres. The total volume of impacted materials is approximately 146,000 yards.

Review of the overland gamma, soil sample analyses, downhole gamma and radon flux measurement results indicates that there are three locations where relatively higher levels of radioactivity are present. The first of these is in Area 1 and includes the area just to the southeast of the facility access road and the Bridgeton Landfill office building extending from approximately boring WL-106 to boring WL-114 and continuing to the east to PVC-38. In Area 2, two locations with relatively higher radioactivity were identified. These include a large area around borings WL-209, WL-226, PVC-4, PVC-6, PVC-7, PVC-19, and PVC-35 in the north-central portion of Area 2, and an area extending from approximately borings WL-234, PVC-10, and PVC-11 to borings WL-210 and WL-216 in the southern portion of Area 2. Given the distance between WL-234 and WL-210, a question could be raised as to whether the area extending from WL-234 to WL-216 is continuous or represents two separate areas.

7.0 CONTAMINANT EXTENT, FATE AND TRANSPORT

This section of the Remedial Investigation report discusses the extent of the existing radionuclide contamination in environmental media at the landfill and the environmental fate and transport of the various radionuclides. Specifically, this section describes the potential environmental pathways by which the radionuclides present in Areas 1 and 2 and on the Ford property have or could migrate from these areas to other portions of the landfill, to offsite areas or to other environmental media. This section of the RI describes the current extent of radionuclide occurrences within the various environmental media that could act as pathways for onsite or offsite migration or contaminant exposure. This section of the RI also discusses the environmental fate and persistence of the various radionuclides present at the landfill including a discussion of the radioactive decay and the subsequent generation of "daughter" radionuclides.

7.1 Extent of Contamination and Potential Contaminant Migration

Pathways by which radionuclides could migrate from the various source areas include airborne transport, dissolved or suspended transport in surface water runoff, erosional transport of surface soil and sediment, and leaching to groundwater and subsequent groundwater transport. A conceptual model of these various transport pathways and the associated transport mechanisms is presented on Figure 7-1.

7.1.1 Airborne transport

Radionuclides can be transported to the atmosphere either as a gas in the case of the various radon isotopes or as fugitive dust in the case of the other radionuclides. Both potential pathways are evaluated below based on site-specific data.

7.1.1.1 Radon Gas

Radon gas is discharged as a result of the decay of radium. Radon gas generated from radioactive decay of radium present within the radiologically impacted materials in the landfill could potentially migrate from the various source areas along either one of two possible pathways:

- Radon could migrate upward and be directly discharged at the surface; and
- Radon could be discharged in the subsurface and travel laterally along with other landfill gases until it is able to escape to the surface.

Both potential pathways and the extent of existing radon occurrences are evaluated below.

7.1.1.1.1 Surface Emission of Radon Gas

The radon flux measurement program completed by EMSI in June 1997 employed the Large Areas Activated Charcoal Canisters (LAACC) method presented in Method 115, Appendix B, 40 CFR, Part 61 (EMSI, 1997a, 1997d). This method was established to measure radon flux values on uranium mill tailing piles. Radon flux was measured rather than concentration because no structures are present in either Area 1 or Area 2 that would result in the build-up of radon concentrations. Instead, the potential transport pathway is the migration of the gas from the landfill into the atmosphere.

The radon flux measurements were made at 54 locations (Figure 4-14) adjacent to the soil boring locations within the grids established for the soil sampling programs within Area 1 (one sample in each of 22 grids) and Area 2 (one sample in each of 32 grids). These locations were developed by McLaren/Hart (1997a) using a stratified random technique consisting of both biased and unbiased sampling locations and are thus, for the large part statistically unbiased. Each sample location in Area 1 is representative of an approximately 38,250 square foot area within individual 170 foot by 225 foot grids. Each sample in Area 2 is representative of an approximately 67,600 square foot area within individual 260 foot by 260 foot grids. In addition to the 18 grid locations established by McLaren/Hart for Area 1, four additional locations, coincident with the four additional borings drilled by EMSI in May 1997 were also used for radon flux measurements. The radon flux monitoring locations are presented on Figure 4-13. The results of the radon flux measurements are summarized in Table 7-1.

No standards for radon emissions directly applicable to the landfill have been established. In 40 CFR Part 61, EPA established a standard of an average of 20 pCi/m^2s for radon emissions for uranium mill tailings from a number of samples (generally 100) collected from the surface of the tailings in a statistically unbiased fashion. Although this standard is only directly applicable to uranium mill tailings, it represents a health-based standard derived by EPA that can be used for comparative purposes until a more specific health-based criterion is developed in the FS based on the results of the BRA.

Based on the radon flux measurements obtained by EMSI (1997d) the average radon flux from Area 1 is 13 pCi/m^2s (Table 7-1). This value is below the standard for uranium mill tailings. Only two discrete radon flux measurements in Area 1, from locations WL-102 (246 pCi/m^2s) and WL-106 (22.3 pCi/m^2s), were above the 20 pCi/m^2s standard for average flux from uranium mill tailing piles. These two locations represent the majority of the total radon flux measured in Area 1. Boring WL-102 had down-hole gamma readings with a maximum peak of approximately 58,000 counts per minute at a depth of approximately three feet; however, the soil samples obtained and analyzed from this boring did not contain radionuclides above reference levels. Boring WL-106 had down-hole gamma readings with a maximum peak of approximately 260,000 counts per minute at a depth of approximately 6.5 feet. Both the surface and subsurface soil samples from boring WL-106 contained radionuclides above the reference levels. The average flux for all of the other portions of Area 1, exclusive of these two locations, is only 0.87 pCi/m^2s, which is approximately 4% of the allowable flux for uranium mill tailing piles.

Based on the radon flux measurements obtained by EMSI (1997d), the average radon flux for Area 2 is 28 pCi/m^2s. This average is above the EPA uranium mill tailings standard; however this value is due solely to the results obtained from two locations, WL-209 (513.1 pCi/m^2s) and WL-223 (350 pCi/m^2s). The results obtained from these two locations represent the vast majority of the radon flux found in Area 2. Boring WL-209 had down-hole gamma readings with a maximum peak of approximately 740,000 counts per minute at a depth of 2.5 feet. The analytical results obtained from the surface and subsurface soil samples from this boring contained radionuclides above reference levels. The maximum down-hole gamma reading displayed in boring WL-223 was only 7,000 counts per minute at a depth of four feet. In addition, analyses of the soil samples from this boring did not indicate the presence of radionuclides above reference levels. As a result, the source of the radon emissions detected at this location is unclear. The average flux for all of the other portions of Area 2, exclusive of these two locations, is only 0.94 pCi/m^2s, which is approximately 5% of the allowable flux for uranium mill tailing piles.

Once the radon is emitted from the surface of the landfill, it will be subject to dilution and dispersion processes active in the atmosphere. The radon flux was measured directly at the ground surface within the confined space of each LAACC. The actual radon emissions will immediately be dispersed by atmospheric movement as the gas migrates from the ground surface, resulting in far less exposure to the potential receptors than was measured using the LAACC. This dispersion effect has been addressed as part of the baseline risk assessment for on-site workers. In assessing potential offsite risks, if any, the effect that additional dispersion will have on radon concentrations as the gas molecules that may be present in the atmosphere migrate toward the landfill boundaries may need to be considered.

7.1.1.1.2 Radon Migration With Landfill Gas

Radon gas from Areas 1 and 2 could also conceivably migrate laterally along with other landfill gases until it emerges at the surface or is captured by the landfill gas collection system on the south side of Area 1. The average radon flux for all 54 measurements across Area 1 and Area 2 is 22 pCi/m^2s. In a worst possible situation, the generated radon gas would migrate toward the collector system; however, radon concentrations would decline as radioactive decay of radon occurs. Given the 3.8-day half-life for radon-222, the primary radon radionuclide of concern, the final concentration at the landfill boundary would thus be substantially lower. In addition, landfill gases generated from the remaining areas of the landfill would further dilute the radon concentrations within the landfill gases as they migrated from their original locations toward the landfill boundaries. As a result, it is reasonable to expect that the radon flux that may be present in landfill gas that migrates to either the gas collection system or the landfill boundaries will be well below the EPA standard of 20 pCi/m^{2}s.

Exposures from radon gas exhausted from the existing landfill flare were evaluated by Golder Associates (Golder Associates, 1995c). Golder collected samples from the flare and evaluated the resulting radon-222 measurements relative to probable risk. Golder concluded, "recent measurements of radon daughter products, to which on-site workers may be potentially exposed via inhalation, are nearly 10 times below the recommended EPA regulatory limit..."

EMSI does not consider radon migration in landfill gas to be a viable migration pathway based upon the following factors:

- Measurements made by Golder of radon concentrations near the landfill office and in the landfill gas collection system;

- The overall average flux measured by EMSI was only slightly above the EPA standard; and

- The anticipated fate and transport processes associated with gas migration within the landfill as discussed above.

7.1.1.2 Fugitive Dust

McLaren/Hart conducted fugitive dust sampling on an extremely windy day (wind speed 14 mph or greater) following a prolonged period with no precipitation to evaluate conditions under a worst-case scenario (McLaren/Hart 1996d). Fugitive dust sampling was performed at boring location WL-114 in Area 1 and at boring location WL-210 in Area 2 (Figures 4-14 and 4-15). These two areas contained radionuclide activities well above the reference levels and at or near the highest levels found in any of the surface soil samples obtained in Areas 1 and 2 (Table 7-2).

Trace levels of both uranium-238 and thorium-232 decay series radionuclides were detected in both the upwind and downwind samples collected from both Area 1 and Area 2 (Table 7-3). The presence of extremely low levels of radionuclides, at or near the minimum detectable activity (MDA) levels, in the fugitive dust samples hampers the evaluation of the results; however, some general observations can be made. Overall, comparison of the results obtained from the upwind and downwind samples indicates that there were little if any differences between the radionuclide levels detected in the upwind and downwind fugitive dust samples. Considering the minimum detectable activity (MDA) values and the sigma errors, it can be concluded that the differences in the radiological results between the upwind and downwind locations are very minor.

Review of the uranium-238 decay series results for Area 1 (Table 7-3) indicates that the thorium-230 and radium-226 levels present in the fugitive dust samples were similar to or lower at the downwind location compared to the upwind results. A slight increase in the thorium-230 level was detected between the upwind and downwind results for Area 2 (Table 7-3). Review of the uranium-235 decay series results indicates that neither the upwind nor the downwind samples obtained from either Area 1 or Area 2 exceeded the MDA values. Review of the thorium-232 decay series results indicates that their activity levels appeared to decrease across the Area 1 fugitive dust sampling location but may increase across the Area 2 sampling location. Based upon the results of the fugitive dust samples, there does not appear to be any significant radionuclide transport via fugitive dust occurring in Area 1. There may be some radionuclide transport via fugitive dust occurring in Area 2; however, the detected levels are so low, and so close to the MDA values, that meaningful interpretation of the results is difficult.

The fugitive dust data were compared to published occupational exposure limit criteria for "stack emissions" (10 CFR Part 20, Appendix B, Tables 1 and 2). These criteria utilized derived air concentrations (DAC) which are equivalent to the concentrations, which, if inhaled or ingested continuously over the course of a year, would produce a total effective dose equivalent to 0.05 rem. Exposure limit concentrations for uranium-238, thorium-230, and radium-226 are provided with these criteria. The most stringent exposure limit levels are for uranium-238 and thorium-230 with the most stringent of these being for thorium-230. The occupational DAC for thorium-230 is 6×10^{-12} microcuries per milliliter (uCi/ml) which is equivalent to 0.006 picocuries per liter (pCi/l). The occupational DAC for uranium-238 is 2×10^{-11} uCi/ml, which is equivalent to 0.02 pCi/l.

The maximum detected uranium-238 and thorium-230 levels in the fugitive dust samples were 0.00071 and 0.00256 pCi/l respectively. These values are below the occupational DAC standards presented in 10 CFR Part 20. As the fugitive dust samples were collected within 40 feet of defined radiologically affected areas, it is anticipated that the levels of radionuclides that may be present in fugitive dust present at the landfill boundary would be substantially lower. Therefore, EMSI concludes that atmospheric transport of radionuclides in fugitive dust does not appear to be a significant pathway for offsite migration under moderately windy conditions given that the site is undisturbed and vegetation remains intact..

7.1.2 Surface Water Transport

Radionuclides present in Areas 1 and 2 could potentially be transported to other portions of the landfill or to offsite areas with precipitation runoff from the landfill. Transport with rainwater runoff would include both dissolved phase transport and suspended phase transport within the flowing runoff water. Transport of radionuclides by these mechanisms is addressed below. In addition, potential impacts to permanent surface water bodies, the actual or potential receptors of any offsite migration of radionuclides in rainwater runoff, are also addressed in this section. Erosional transport of soil and sediment in conjunction with rainwater runoff or other processes is discussed in the next sub-section of this report.

7.1.2.1 Rainwater Runoff Transport

The second possible pathway by which radionuclides present in Areas 1 and 2 could migrate offsite is through erosion by precipitation and subsequent transport in rainwater/snowmelt runoff. Transport of radionuclides in runoff occurs by three possible mechanisms, dissolved transport, transport of suspended sediment and transport of bedload sediment. The first two of these mechanisms are discussed in this sub-section. Sediment transport is discussed in the next sub-section.

Dissolved and total concentrations measured in the rainwater/runoff samples obtained from various locations (Figure 4-1) during the RI were compared to published standards and criteria to assist in the identification of contaminant occurrences and to perform an initial evaluation of the magnitude and significance of these occurrences. The primary criteria considered were the drinking water standards for raduim-226, radium-228 and gross alpha particle radioactivity published in Section 10 CSR 60-4.060 of the Missouri Code of State Regulations. These standards include the following:

> *For radium-226, radium-228 and gross alpha particle radioactivity, the maximum contaminant level (MCL) shall be:*
>
> > *Combining radium-226 and radium-228, five picocuries (5pCi) per liter. A gross alpha particle activity measurement may be substituted for the required radium-226 and radium-228 analysis, but only if the measured gross alpha particle activity does not exceed five (5) pCi/l.*
> >
> > *Measuring gross alpha particle activity, including radium-226 but excluding radon and uranium, fifteen (15) pCi/l. When the gross alpha particle activity exceeds five (5) pCi/l, the same or an equivalent sample must be analyzed for radium-226. If the concentration of radium-226 exceeds three (3) pCi/l the same or an equivalent sample shall be analyzed for radium-228.*

In order to assess the potential for radionuclide migration in rainwater runoff, McLaren/Hart installed weirs at nine locations to obtain runoff flow measurements and samples of rainwater runoff (McLaren/Hart, 1996e). These nine locations included four locations in Area 1 and five locations in Area 2 (Figure 4-13). An additional location (weir 10) was established by EMSI in Area 2 to assess the effects of mixing of Area 2 runoff with runoff from other areas of the landfill outside of Areas 1 and 2 at weir 9 (Figure 4-13).

The EPA approved RI/FS Work Plan envisioned that all nine locations would be sampled during the same runoff event; however, during the initial RI field investigations, runoff sufficient to allow for sample collection was not present at all nine locations during any particular precipitation event (McLaren/Hart, 1996e). In addition, the EPA approved RI/FS Work Plan did not include analysis of the runoff samples for gross alpha radioactivity. Furthermore, the MDA levels achieved during the initial sampling events were not sufficiently low enough to allow for comparison of the results to the Missouri standards. As a result, additional sampling was performed by EMSI pursuant to an Amended Sampling and Analysis Plan (ASAP) approved by EPA (EMSI, 1997a). Precipitation events performed subsequent to EPA's approval of the ASAP were also not sufficiently intense to permit sampling of all of the runoff locations.

Although neither McLaren/Hart nor EMSI were able to obtain samples from all of the runoff locations during a single sampling event, samples were obtained from nine of the ten runoff locations (all except weir 6) during the various sampling events. At some of the sample sites (weirs 8 and 9), flowing water was not present at the time of sample collection; however, ponded water was present at these locations and samples of the ponded water were obtained. The analytical results for rainwater runoff samples collected by McLaren/Hart and EMSI are presented in Appendix D.

Review of the rainwater runoff results indicates that radium levels above the drinking water standard were only present in the sample from weir 9. Specifically, the radium-226 level detected in the unfiltered sample obtained in April 1996 from this location was 8.85 pCi/l compared to the drinking water standard of 5 pCi/l. The filtered sample obtained from this location during the same sampling event contained only 0.80 pCi/l indicating that the majority of the radium-226 detected in the unfiltered sample is present as suspended sediment. Due to high MDA levels, the radium-228 results for this sampling event are meaningless. Subsequent sampling of rainwater runoff from this location in May 1997 indicated that the combined radium-226 (0.32 pCi/l) and radium-228 (<0.87 pCi/l) did not exceed or even come close to the drinking water standard.

As will be discussed below as part of the evaluation of sediment migration, the fate of any surface water or sediment that migrates from the vicinity of weir 9 would be to enter the drainage ditch along the interior access road. From the drainage ditch along the interior access road, surface water and transported sediment would potentially flow into the drainage ditch along the north side of the landfill access road and ultimately could enter the perimeter drainage ditch along St. Charles Rock Road. Any runoff water or sediment that enters the perimeter drainage ditch would flow into the North Surface Water Body.

In addition to radium-226, McLaren/Hart analyzed rainwater runoff samples from Area 1 for thorium-228, -230, and –232 as well as uranium 235/236 and uranium 238. With the exception of uranium-238, the concentrations of these radionuclides were well below 1 pCi/l. The concentrations of uranium-238 varied from 0.36 pCi/l to 3.66 pCi/l.

The rainwater runoff samples from Area 2 were analyzed by McLaren/Hart for all the radionuclides in the three decay series; however, the minimum detectable activity levels for thorium-234, lead-214, bismuth-214, lead-210, uranium-235, protactinium-231, actinium-227, radium-223, radium-228, radium-224, lead-212, and thallium-208 all exceeded 10 pCi/l. The radionuclides measured in the rainwater runoff sample from weir 5 had concentrations that generally ranged from 1 to 6 pCi/l except for uranium-234 and uranium-238 for which the concentrations generally ranged between 40 and 49 pCi/l. The other Area 2 sampling locations displayed radionuclide concentrations that were similar to those measured in the rainwater runoff samples obtained in Area 1.

Based on these analytical results, rainwater runoff represents a potential pathway for radionuclide migration from Areas 1 and 2. Rainwater runoff potentially containing dissolved or suspended radionuclides could potentially be transported from Area 1 or the southeastern portion of Area 2 into the drainage ditches at the landfill. Depending upon the magnitude and duration of the storm event associated with any rainwater runoff transport, dissolved or suspended radionuclides could be further transported into the perimeter drainage ditch along the along the northeastern boundary of the landfill (southwestern side of St. Charles Rock Road). From the perimeter drainage ditch, dissolved or suspended radionuclides could potentially enter the North Surface Water Body depending upon the magnitude and duration of the rainwater runoff. Similarly, rainwater runoff potentially containing dissolved of suspended radionuclides could potentially be transported from the western portions of Area 2, down the landfill slope and onto the Ford property.

In either case, depending upon the magnitude and the duration of the rainwater runoff event, the resultant surface water flow may not extend all the way to the North Surface Water Body or all the way on to the Ford Property. The extent to which the suspended or dissolved radionuclides are transported via rainwater runoff depends upon the magnitude of the precipitation event and the resultant surface water runoff. If continuous surface water flow is not established all the way to the North Surface Water Body or the Ford Property, the dissolved and suspended radionuclides will be deposited as sediment along the drainage channels. Once deposited, these materials could remain in place, become buried by subsequent sediment deposition, or be eroded and re-suspended or dissolved by a subsequent runoff event and be further transported along the drainage channels. Ultimately, given sufficient flow from a single event or sufficient flow and erosion from multiple events, any radionuclides that are transported by rainwater runoff from Areas 1 and 2 could be deposited along with other sediments in the North Surface Water Body or on the surface of the Ford Property.

7.1.2.2 Surface Water Samples

Along with the sampling and analysis of rainwater runoff samples, samples of permanent surface water adjacent to the landfill into which runoff from the landfill may flow were also collected to assess the nature and extent of contamination at and migrating from Areas 1 and 2. The two surface water bodies adjacent to the landfill are the North Surface Water Body and the Earth City Flood Control Channel. The surface water sampling locations associated with these two water bodies are shown on Figure 4-13. As was discussed in the previous section, runoff from Areas 1 and 2 could potentially flow into the North Surface Water Body. Based on topographic conditions, it does not appear that runoff from Areas 1 and 2 could enter the Flood Control Channel.

McLaren/Hart and EMSI each collected surface water samples from these two surface water bodies. Sampling point SW-1 was established by McLaren/Hart (1996e) in the Earth City Flood Control Channel near the northwestern boundary of the landfill just to the west of Old St. Charles Rock Road. Sampling point SW-2 was established by McLaren/Hart (1996e) in an area of ponded water located at the north end of the drainage ditch on the south side of St. Charles Rock Road which was identified by McLaren/Hart as the "North Surface Water Body." This second surface water sampling point is located immediately north of the landfill property.

The results of the sampling and analyses of these two surface water locations are included in Appendix D. Gross alpha measurements were only obtained in 1997. These results did not exceed the Missouri MCL of 5 pCi/l for gross alpha. Furthermore, none of the radium sample results exceeded the Missouri MCLs of combined total for radium-226 and radium-228 of 5 pCi/l.

The radium-228 results obtained by McLaren/Hart (1996e) could not be directly evaluated relative to the MCL because of high MDA levels (>200 pCi/l). The radium-226 concentrations detected in the McLaren/Hart samples were generally less than the concentrations detected in the EMSI samples. The activities for radium-226 and radium-228 were nearly equal for each sample collected by EMSI. Assuming the radium-228 concentrations in the McLaren/Hart samples also are approximately equal to the radium-226 values, then the McLaren/Hart results would not have exceeded the MCLs.

Based on the results of the rainwater runoff sampling, dissolved or suspended transport in rainwater runoff does represent a potential migration pathway for transport of radionuclides from Areas 1 and 2. Given the relatively low levels of radionuclides present in rainwater runoff and the lack of significant impacts in the surface water bodies, this pathway is not considered to be a major mechanism for transport of radionuclides from Areas 1 and 2. As will be discussed below, transport of sediment in conjunction with rainwater runoff represents a more significant migration pathway.

7.1.3 Sediment Transport

Erosional transport of soil and sediment onsite and offsite was the third migration pathway identified for OU-1. Potential sediment transport pathways include surface drainage channels and erosion of sediment from the northern slope (landfill berm) of Area 2.

7.1.3.1 Sediment Transport in Surface Drainage Channels

To assess the potential migration of radionuclides in sediment along the surface water drainage channels, samples were obtained of the sediments present at each of the various rainwater runoff locations. Two sets of sediment samples were collected. The first set of sediment samples were collected by McLaren/Hart from the Area 1 weir locations in May 1995 and from the Area 2 weir locations in April 1996 (McLaren/Hart, 1996e). A second set of sediment samples was collected by EMSI in May 1997. The purpose of collecting these sediment samples was to evaluate the extent of radionuclide transport in sediments from the various weir locations.

Analytical results for the sediment samples collected during each of these sampling events are summarized in Appendix E. The surface soil reference levels are also included on tables contained in Appendix E as no specific standards exist for sediment materials. As discussed in detail at the beginning of Section 6, these standards are only applicable to uranium and thorium mill tailings sites and health based criteria appropriate for use in OU-1 will be developed as part of the FS based upon the results of the BRA evaluations.

Results of the sediment sampling and analysis indicate that radiological constituents are present in sediments above surface reference levels at weirs 1 and 2 in Area 1 and at weirs 5, 6, 7 and 9 in Area 2. The exit points for sediment from OU-1 differ for Area 1 and Area 2 so they will be discussed separately.

7.1.3.1.1 Area 1 Surface Drainage

The sediment samples from weirs 1, 2, 3 and 4, which are located in Area 1, represent soil material eroded from the surface of Area 1. Based upon the surface topography of Area 1, soil eroded from the surface of Area 1 is transported to the north-northwest to the drainage ditch located on the north side of Area 1 along the south side of the main landfill access road. Accumulated sediments in the drainage ditch along the north-northwest boundary of Area 1 can potentially be transported to the northeast along the ditch to the landfill boundary. From this drainage ditch, transported sediments could migrate into the landfill perimeter drainage ditch located on the southwest side of St. Charles Rock Road. Water and sediments present in the landfill perimeter drainage ditch along the southwest side of St. Charles Rock Road could subsequently migrate to the northwest to the North Surface Water Body located just to the north of the northernmost extent of the landfill.

McLaren/Hart collected sediment samples from each of the four weir locations in Area 1 (Figure 4-13) in May 1995. Results of the analyses of these samples indicated that the sediment present at weir 2 contained several radionuclides of the uranium-238 and uranium-235 decay series at concentrations greater than their respective reference levels. Radionuclide concentrations greater than reference levels included thorium-230, radium-226, lead-214, bismuth-214 and lead-210 of the uranium-238 decay series and protactinium-231, actinium-227 and radium-223 of the uranium-235 decay series. Sediment samples from the other three weir locations did not contain radionuclide concentrations above reference levels; however, some of these samples did contain radionuclide concentrations greater than background levels.

As discussed above, sediment samples obtained from weir 2 in Area 1 (Figure 4-13) contained radionuclides, (principally but not exclusively thorium-230, radium-226, and lead-210) at levels greater than the surface soil reference levels (Tables E-1, E-2 and E-3 in Appendix E). Although the original RI sediment samples obtained from Weir 3 did not contain radionuclides above reference levels, the subsequent sample obtained in May 1997 as part of the ASAP testing did contain thorium-230 at 11.6 pCi/g compared to a reference level of 7.54 for this isotope. In addition to the above locations, samples from weir 1 in Area 1 contained throium-230 and radium-226 at levels greater than background but less than the reference levels. None of the samples obtained from weir 4 located along the north side of Area 1 immediately south of the landfill office building contained radionuclides above background levels.

In order to assess the extent of radionuclide transport in sediments from Area 1, EMSI subsequently collected sediment samples from four locations along the access road drainage ditch and the landfill perimeter drainage ditch in May 1997. These four additional sample locations are also presented on Figure 4-13.

Sample SED 1 is located at the intersection of the property boundary and the drainage ditch south of the main landfill access road. An original and a duplicate sample were obtained by EMSI from this location. Both of these samples contained radionuclides at, or slightly exceeding, the surface reference levels; however, the specific constituents exceeding reference levels varied in the two samples. The primary sample contained radium-226 at an activity level slightly higher than the reference level (6.7 pCi/g verses 6.3 pCi/g); however radium-226 was not detected in the duplicate sample (the minimum detectable activity level was 5.06 pCi/g for the duplicate sample). Similarly, the duplicate for sample SED 1 contained uranium-234 at an activity level of 16.3 pCi/g verses a reference level of 7.73 pCi/g; however, the original SED 1 sample had a measured level of uranium-234 of only 0.95 pCi/g. The results indicate that significant heterogeneity in the radionuclide occurrences in sediment exist on a localized basis. Other than uranium-234 and radium-226, no other radionuclides were detected above the surface reference level in either the original or duplicate sample from location SED 1.

Samples were also collected in the drainage ditch north of the landfill access road (SED-2) and at two locations in the perimeter drainage ditch situated along the edge of St. Charles Rock Road (SED-3 and SED-4, see Figure 4-13). No radionuclides, including radium-226 and uranium-234, were detected above their respective surface reference levels in any of these samples.

Although thorium-230 was not detected above its reference level in any of the internal or perimeter drainage ditches, samples obtained from SED-1, SED-3 and SED-4 all contained thorium-230 above its background level. The sample from SED-4 also contain radium-226 above the background level. The sample from the SED-2 location did not contain any radionulcides at levels above reference or background levels.

It should be noted that some of the minimum detectable activity values obtained for the sediment samples slightly exceeded their respective reference levels. Most notably, the MDA levels for some of the lead-210, protactinium-231, radium-223, radium-224 and the bismuth-212 analyses exceeded their respective reference levels. The most significant deviation of the MDA levels relative to the reference levels occurred in samples SED-3 and the duplicate to SED-1, which had excessively high minimum detectable activity values for lead-210. Although some of the sample analyses had MDA values above the reference levels, review of the results does not indicate that the elevated MDA values have affected the evaluation of the nature and extent of contamination. Duplicate samples with appropriate MDA values were available for some of the samples or the results of the analyses for the other radionuclides in each of the decay series were sufficient to assess whether or not contamination was present at each of the sample locations.

Based on the results of the sediment sampling, erosion of surface soils in Area 1 and subsequent sediment transport to the north-northwest boundary of Area 1 into the landfill access road drainage ditch has occurred and continues to occur in response to significant precipitation events. Sediment transport along the landfill access road drainage ditch into the landfill perimeter drainage ditch along St. Charles Rock Road also has occurred; however, the available sediment data do not indicate that transport of contaminated sediments has occurred down (to the northwest) along the landfill perimeter drainage ditch. Elevated levels of radionuclides were not detected in the sediment sample obtained from location SED-3. In addition, based on the analyses of the sediment sample from location SED-4, elevated levels of radionuclides are not present in the sediments in the North Surface Water Body. Presumably, any sediments that may have been transported from Area 1 to the landfill perimeter drainage ditch apparently have accumulated upstream (south) of the culvert beneath the landfill access road.

Although the sediment sampling results did not indicate that sediment transport has occurred along the landfill perimeter drainage ditch north of the culvert beneath the landfill access road, the potential for sediment migration to the northwest along the landfill perimeter drainage ditch cannot be eliminated. To the extent that sediment transport occurs along the landfill perimeter drainage ditch, it is anticipated that any sediments that may be transported along this pathway would accumulate in the North Surface Water Body and due to the stilling effects of this water body, would not be transported further offsite.

7.1.3.1.2 Area 2 Surface Drainage

Sediment samples were obtained from the five original weir locations (weirs 5, 6, 7, 8, and 9) in Area 2. Weirs 8 and 9 are located in the southwestern portion of Area 2. Runoff and sediment from the southwest portion of Area 2 is transported to the southeast along the drainage located adjacent to the internal access road that ultimately joins the drainage ditch along the landfill access road. Any sediments transported from Area 2 along the internal access road drainage to the landfill access road drainage ditches could potentially be transported to the perimeter drainage ditch along St. Charles Rock Road and ultimately could enter the North Surface Water Body.

Review of the analytical results for the sediment samples obtained from the locations of weirs 8 and 9 indicates that none of the radionuclides exceeded reference levels in the samples obtained from weir 8 but that reference levels were exceeded in the samples from weir 9. Specifically, with the exception of the uranium isotopes, all of the radionuclides of the uranium-238 decay series were detected at concentrations greater than their respective reference levels. Most notably, the thorium-230 levels in sediment at weir 9 were 20 to 150 times greater than the reference level. The other thorium isotopes (thorium-232 and thorium-228 of the thorium-232 decay series) were also present at concentrations above their reference levels in the sediment samples from this location. Actinium-227 (uranium-235 decay series) was also detected at slightly above its reference level in the May 1997 sediment sample from this location.

As discussed above, sediment samples obtained from weirs 5, 6, 7 and 9 in Area 2 (Figure 4-13) contained radionuclides, (principally but not exclusively thorium-230, radium-226, and lead-210) at levels greater than the surface soil reference levels (Tables E-1, E-2 and E-3 in Appendix E). Both samples obtained from weir 8 in Area 2 contained thorium-230 at levels greater than background but less than the reference levels.

Surface water and sediment transport from Area 2 through the vicinity of weir 9 would flow along the interior access road to the drainage ditch located along the northern side of the landfill access road to the perimeter drainage ditch along St. Charles Rock Road. Sample SED-2, collected from the landfill perimeter drainage ditch at the confluence with the northern drainage ditch along the landfill access road, contained no radionuclides above reference levels; therefore, sediment migration from weir 9 does not appear to extend to offsite areas.

The available sediment data suggest that transport of contaminated sediments from Area 2 to the landfill perimeter drainage ditch along St. Charles Rock Road has not occurred. Rather, these data suggest that any sediment that may be transported from Area 2 along the internal access road drainage ditch to the landfill access drainage ditch, have accumulated within these drainage ditches and have not migrated beyond the landfill boundary. However, the available sediment data are insufficient to eliminate the possibility that contaminated sediment within the landfill interior drainage ditches could potentially be transported to the landfill perimeter drainage ditch. To the extent that sediment transport would occur along the landfill perimeter drainage ditch, any sediment that may be transported along this pathway would accumulate in the North Surface Water Body and due to the stilling effects of this water body, would not be expected to be transported further offsite.

Sediment samples were also obtained from weirs 5, 6 and 7 along the northwest portion of Area 2 at the top of the landfill slope above the Ford property. All three of these locations potentially drain down onto the Ford property into the buffer area to the north of Area 2. Uranium-238 decay series radionuclides were detected in the sediment samples obtained from all three of these locations, most notably from weir 5, at concentrations slightly greater than the reference levels. In addition, as will be discussed below, sediment transport from Area 2 down the landfill berm onto the Ford property has occurred historically. A potential exists for future erosion and transport of Area 2 surface soils down the landfill berm and potentially out onto the Ford property. Based on the limited amount of runoff observed in weirs 5, 6 and 7 during rainwater runoff sampling activities, sediment transport from Area 2 down the landfill berm is an infrequent event that apparently only occurs in response to major storm events.

Based on the results of the soil sampling on the Ford property, erosion of surface soils in Area 2 and subsequent sediment transport onto the Ford property has occurred. Although the rainwater runoff and sediment sampling results did not indicate that sediment transport from Area 2 onto the Ford property continues to occur, the potential for such transport in response to significant precipitation events cannot be discounted.

7.1.3.2 Sediment Transport From Area 2 Slope Erosion

The northern portion of Area 2 is characterized by a landfill berm of approximately 20 to 25 feet average height. Reportedly, a historic failure of this berm occurred resulting in transport of radiologically impacted materials from Area 2 onto the adjacent Ford property. The exact nature of this historic failure has not been described in any of the previous reports of conditions at the landfill. In addition, the area of this historic failure has subsequently become heavily vegetated, as has all of the landfill berm slope, and therefore no visual evidence of this historic failure remains.

It has been postulated that the occurrences of radionuclides on the Ford property possibly were the result of significant mass wasting (landslide or other slope failure) of the slope; however, the available data indicate that this is not correct. Specifically, based upon inspection of the area, review of aerial photographs and reports of individuals present at the time, the reported "slope failure" actually was scouring and erosion associated with runoff and erosion. Specifically, rainwater runoff flowed across and eroded channels in the surface of Area 2 and the landfill berm as a result of the presence of a road along the landfill slope that acted to collect and focus runoff from Area 2 down the face of the landfill berm. This runoff and erosion was subsequently stopped through the construction of runoff diversion berms and natural revegetation of the landfill slope. This historic erosional scour resulted in transport of soil, some of which contained radionuclides, from Area 2 down onto the adjacent Ford property where it meets the toe of the landfill berm.

The conclusion that the historic transport of radionuclides onto the Ford property was the result of erosional processes rather than mass wasting is further supported by observations made and data obtained during the RI. First, occurrences of radionuclides on the Ford property are limited to surficial materials with a depth of six or at most twelve inches or less. The shallow depth of radionuclide occurrences on the Ford property are not consistent with a deep seated failure but instead are consistent with erosional transport and sediment deposition processes in response to an extreme storm event(s). In addition, the establishment of extensive vegetative growth, including mature trees, along the landfill berm is inconsistent with an unstable slope. Furthermore, no slope failure or significant erosional loss was observed to occur during the record precipitation events recorded in 1993 and 1995. Detailed discussions of these observations were previously presented in Section 4.4.4.5 of this RI report.

Regardless of the mechanism of past transport, soil samples collected by McLaren/Hart and by EMSI indicate that transport of radiologically impacted soils from Area 2 onto the Ford property adjacent to Area 2 has historically occurred. Although the establishment of vegetation on the landfill berm and construction of a surface water diversions both act to significantly reduce or possibly eliminate future erosional transport of Area 2 soils onto the Ford property, the potential for future transport of Area 2 soils onto the Ford property still exists. Results of the analyses of the erosional weir sediment samples obtained from this area (weir locations 5, 6 and 7) indicates that some limited transport of soil/sediment potentially could occur from the berm along the western portion of Area 2 in response to major storm events. Specifically, at weir 5, the sediments contained levels of several uranium-238 decay series constituents above both background and reference levels. Other than actinium-227, constituents of the uranium-235 and thorium-232 decay series were either not detected or not detected above background levels in the sample from this location. The thorium-230 levels in the samples from weir locations 6 and 7 also exceed the reference level. Radium-226 and lead-214 were detected at levels above the reference level in the sample from weir location 6. Therefore, erosion and subsequent transport of surficial soils within Area 2 continues to occur; however, routine storm flows appear to be insufficient to transport these sediments from Area 2 onto the Ford property.

Analytical results from soil samples collected from the Ford property during implementation of the ASAP (previously discussed in Section 6.8) indicate that past transport of radionuclides onto the Ford property was limited to the upper 6-inches of soil. The potential for future significant erosional failure of the landfill slope prior to implementation of the remedy appears to be minimal based on the following:

- The presence of diversion berms at the top of the landfill slope;
- The surface and vegetative conditions along the slope;
- Evaluation of sediment erosion and deposition mechanisms; and
- The lack of discernible erosion on the slope following significant precipitation events in 1993 and 1995.

However, transport of sediments from Area 2 onto the Ford property does represent a potential pathway for offsite migration of radionuclides.

7.1.4 Groundwater

The fourth migration pathway identified for OU-1 was discharge of perched water or leachate within the landfill to surface water bodies or downward migration of landfill leachate to the alluvial groundwater system and subsequent transport within the groundwater system to offsite areas.

7.1.4.1 Migration of Radionuclides into Perched Groundwater or the Leachate Seep

During the drilling of the various borings in Areas 1 and 2, shallow perched water was encountered at several locations. In addition to the perched water, one leachate seep was identified in the northwest corner of Area 2. Figure 4-10 presents the distribution of perched water identified within the landfill in Areas 1 and 2 and the location of the leachate seep. As can be seen from Figure 4-10 and as indicated by McLaren/Hart in the Soil Boring/Surface Soil Investigation Report (McLaren/Hart, 1996h), the distribution of perched water is of limited extent and the various perched waters are isolated in nature. Surface seepage of perched water appears to only occur in the southwestern corner of Area 2 at the location of the leachate seep identified by McLaren/Hart.

Four perched water samples, including one from Area 1 and three from Area 2, were collected by McLaren/Hart and analyzed for radionuclides. In addition, one sample was obtained from the leachate seep. Results of the perched groundwater and leachate sample radiological analyses are presented in Appendix C along with a complete compilation of all of the analytical results for the perched water and leachate seep samples.

Results of the radiological analyses indicate that uranium-238 decay series constituents were present in both the perched water samples and the Area 2 leachate seep. Uranium-238, thorium-234, uranium-234 and thorium-230 were detected in the perched water samples. All of the radionuclides were present at levels less than 1 pCi/l except for thorium-230 in the WL-220 (1.72 pCi/l) and WL-231 (3.70 pCi/l) perched water samples. Uranium-238, uranium-234 thorium-230 and radium-226 were all present at levels less than 1 pCi/l in the Area 2 seep samples. No uranium-235 decay series constituents were detected in the perched water samples. Thorium-232 decay series constituents were detected in only one of the perched water samples: the sample obtained from boring WL-219 in Area 2. This sample contained low levels of thorium-232 (0.042 pCi/l) and thorium-228 (0.12 pCi/l).

The levels of the uranium-238 decay series constituents detected in the leachate seep samples were similar to those found in the background groundwater monitoring wells. In addition, radium-226 was detected at 0.83 pCi/l in this sample, well below the MCL of 5 pCi/l for radium-226 and radium-228 combined. No analytical results are available for radium-228 due to elevated MDA values.

Based on the limited and isolated nature of the perched water and leachate seep, and the overall low levels of radionuclides detected in these samples, the perched water and/or leachate seep do not represent a significant source or pathway for migration of radionuclides from OU-1.

7.1.4.2 Existing Radionuclide Levels in Groundwater

A compilation of all of the groundwater results is presented in Appendix C. Constituents in the uranium-238, uranium-235 and thorium-232 decay series were detected in both of the upgradient background wells (S-80 and MW-107). Constituents in the uranium-238, uranium-235 and thorium-232 decay series were measured near background levels in the non-background landfill wells. Constituent levels were generally below 3 pCi/l in the landfill wells. In addition, there were minimal differences between the results obtained from the filtered and unfiltered samples.

As discussed earlier, the Missouri MCLs apply to combined analysis of radium-226 plus radium-228 and/or gross alpha radioactivity. The groundwater samples collected in May 1997 were the only samples analyzed for gross alpha, radium-226 and radium-228. The analytical results indicate that only the sample from Well D-6 exceeded the State MCLs. The value measured at D-6 was very close to the MCL (a combined radium-226 and radium-228 value of 5.98 pCi/l verses the MCL value of 5.0 pCi/l). The unfiltered result of 1.80 pCi/l for radium-226 detected in May 1997 is similar to the value of 1.88 pCi/l reported by McLaren/Hart (1996g) for the 1996 sampling. The filtered results obtained from this well during these two sampling events were also quite close, 1.66 pCi/l in May of 1997 compared to 2.03 pCi/l in May of 1996.

Table 7-4 presents a summary of all of the RI radium-226 results for the wells sampled in May 1997. These data indicate that the radium-226 concentrations from the previous sampling events were similar to the May 1997 results. Based on this similarity, it can be assumed that the actual radium-228 concentrations from previous sampling events would also have been similar to those measured in May 1997. Therefore, with the possible exception of well D-6, the combined radium concentrations present in the groundwater during the previous sampling events performed by McLaren/Hart were likely also below MCLs.

Well D-6 is a deep alluvial well located at the toe of the landfill berm within the buffer zone on the Ford property along the northwestern boundary of Area 2 (Figure 4-12). Groundwater flow in this area is expected to be generally to the north-northwest, sub-parallel to the Missouri River valley and towards the river (Figures 5-3 through 5-6). Therefore, well D-6 is located downgradient of both Area 1 and Area 2. As previously discussed, the groundwater velocity within the alluvial aquifer is approximately 0.1 feet per day but could range from a low of 0.003 to a high of 0.4 feet per day.

Well D-6 is part of a three well cluster located in the buffer zone on the Ford property at the toe of the landfill berm along the northern boundary of Area 2. The other two wells in this cluster are wells S-61 and MW-102. The levels of radium-226 found in well S-61 are similar to those found in background well MW-107 and less than the levels found in background well S-80. Radium-228 was not detected in well S-61; however, the MDA levels were quite high for these analyses. Well MW-102 was not sampled as part of the RI effort. Ford's consultant (Dames & Moore, 1991) sampled this well prior to the RI effort. Results of the analysis of the unfiltered sample from this well found radium-226 at 1.1 pCi/l and did not detect radium-228 at a detection limit of 1.4 pCi/l. Neither radium isotope was detected in the filtered sample from this well. Based on the results of these and other groundwater analyses, Dames & Moore (1991) concluded, "...only four (4) of the sixteen (16) samples showed detectable Ra-226 concentrations, all of which were within normal background levels of 1 pCi/l (1.1 to 1.6)." Based on both the RI and the Dames & Moore results, it does not appear that the source of the radium occurrences in well D-6 is the result of vertical migration from overlying soils or shallower groundwater.

The S-10, I-11, and D-12 well cluster is located approximately 500 feet to the southeast, and approximately upgradient from the D-6 well cluster. The S-10 well cluster is located within the boundaries of Area 2. Review of the analytical results obtained from these three wells indicates that the radium-226 levels in the groundwater upgradient of the D-6 well cluster are less than 1 pCi/l, similar to, or less than the levels found in the upgradient, background wells. The radium-228 results from these wells are generally non-detect; however, the MDA levels were high. The only exception is the May 1997 radium-228 results obtained from deep well D-12 which indicate that the radium-228 level ranged from 0.47 to 0.67 pCi/l, again within the expected background levels. Based on the lack of elevated radium levels in any of the wells located immediately upgradient of well D-6, it does not appear that the source of the radium levels detected in well D-6 is from upgradient groundwater.

Based upon the available data, the source of the radium levels found in well D-6 cannot be ascertained. It is possible that the radium concentration detected in this well could be the result of either vertical migration from the overlying radiologically impacted materials or from lateral migration from upgradient areas. However, the available data do not support either of these mechanisms as the source of the radium levels in well D-6. One possible source of the radium levels in well D-6 is cross-contamination during drilling activities. It is possible that some of the surficial soil containing radionuclides that are present on the Ford property in the vicinity of well D-6 were knocked into or otherwise released into the boring during the drilling or construction of well D-6. If this did occur, the introduced soil could act as a source of the observed groundwater occurrences of radium in this well.

Even considering the results from well D-6, EMSI does not believe that groundwater transport represents a significant pathway for radionuclide migration from OU-1 for the following reasons:

- The radium exceedance in well D-6 is only slightly above the MCL;
- Although well D-6 is offsite of the property, it is still within the buffer zone;
- Radionuclides were not detected above MCLs in other landfill wells; and
- Radionuclides have a low solubility in water.

This conclusion is consistent with a previous conclusion made by RMC as part of their investigation of the radiological materials at the West Lake landfill (RMC, 1982). RMC concluded, "These results indicate that the buried ore residues are probably not soluble and are not moving off-site via ground water."

7.1.4.3 Future Leaching to Groundwater and Subsequent Off-site Transport

The existing monitoring results do not indicate that leaching to groundwater and subsequent transport with flowing groundwater currently represents a significant pathway for radionuclide migration from OU-1. This section evaluates whether the potential exists for this pathway to possibly be significant in the future. With continued radioactive decay of the parent uranium and thorium isotopes, the levels of radium will increase over time. Such increases in the levels of radium in the source areas could potentially result in increased levels of radium in the underlying groundwater in the future. Based upon the results of the evaluations presented below, it is EMSI's opinion that leaching of radionuclides and subsequent impacts to the underlying groundwater have not and likely will not occur in the future.

7.2 Contaminant Fate and Persistence

This section of the RI addresses the radioactive decay of the various radioisotopes present at the landfill, the generation of "daughter " products, and the projected changes in radionuclide levels in the source areas over time.

7.2.1 Radioactive Decay

Radioisotopes, like all elements, are composed of smaller particles including protons (positively charged particles with significant mass), electrons (negatively charged particles without significant mass) and neutrons (neutrally charged particles with significant mass). The primary fate of all radioisotopes is radioactive decay whereby the nucleus of an atom spontaneously decomposes thereby changing its identity and releasing energy. Radioactive decay results in conversion of one of the three particles of the atom into another type of particle with the consequent release of energy. The type of radiation emitted by the radioactive substances describes the methods of radioactive decay. The three most common types of emissions are alpha, beta, and gamma rays.

Alpha emissions consist of a stream of helium nuclei (a proton) known as alpha particles. With alpha decay, both the atomic number (number of protons) and the atomic mass (number of protons and neutrons) changes. For example, the decay of uranium-238 to thorium-234 occurs through the loss of an alpha particle and the atomic number of the original uranium-238 is reduced from 92 (uranium) to 90 (thorium) and the atomic weight is reduced from 238 to 234 resulting in generation of thorium-234.

A second type of radioactive decay occurs through emission of beta rays. Beta rays consist of a stream of electrons. Emission of beta rays can be thought of as converting a neutron into a proton, thereby increasing the atomic number by one but maintaining the same atomic weight. For example, thorium-234 decays to protactinium-234, which decays to uranium-234, all of which occur through emission of beta particles. The atomic weight of all three isotopes is the same, 234; however, the atomic number of the thorium-234 (90) is increased to 91 in the decay to protactinium-234. Decay of the protactinium-234 to uranium-234 further increases the atomic number to 92.

The third type of radioactive decay is through emission of gamma rays. Gamma rays consist of electromagnetic radiation of very short wavelength (that is high-energy photons). Emission of gamma rays changes neither the atomic number nor the atomic mass number of a nucleus.

Figures 7-2, 7-3 and 7-4 present the three radioactive decay series of interest to the OU-1 RI/FS; the uranium-238 decay series, the uranium-235 decay series and the thorium-232 decay series.

7.2.2 Changes in Radionuclide Concentrations

As a result of radioactive decay, some radioisotopes will decrease in concentration over a given period of time while others may increase over the same period of time. The equation defining the rate of decay, or in-growth, is a first order (logarithmic) equation based on the concept of a half-life. The half-life is the amount of time it takes one half of the radioisotope to decay.

The amount of a radioisotope that decays over a given period of time can be calculated as follows:

$$\text{Log } N_o/N_t = k\,t / 2.30$$

Where:

N_o = the initial number of nuclei (initial concentration) at zero time;
N_t = the number of nuclei (concentration) at a given time;
k = the radioactive decay constant; and
t = the time interval of interest.

The radioactive decay constant is defined as follows:

$$k = 0.693 / t_{1/2}$$

Where $t_{1/2}$ is the half-life of the radioisotope of interest.

Substituting the formula for the radioactive decay constant into the formula for radioactive decay and substituting concentration for the number of nuclides yields the following:

$$\log c_o / c_t = 0.3\,t / t_{1/2}$$

This equation can be used, for example, to calculate the amount of radium-226, which has a half-life of 1,602 years that will remain after thirty years of radioactive decay. For a material with an initial concentration of radium-226 of 1,000 picocuries per gram, the amount of radium-226 remaining at the end of thirty years can be calculated as follows:

$$\log c_o / c_t = 0.3\,(30) / 1602 = 0.0056$$

Therefore,

$$c_o / c_t = 1.013$$

For c_o equal to 1,000 pCi/g,

$$c_t = 1000 / 1.013 = 987 \text{ pCi/g}$$

Therefore, the concentration of the radium remaining after thirty years would be 987 pCi/g.

This basic equation can be used to calculate not only the decay of a particular radioisotope, but also the in-growth of a daughter product as a result of radioactive decay. The equation for in-growth of a daughter product is as follows (Cember, 1988):

$$A_d = A_{po}\,(T_p/T_p - T_d)\,(e^{-\lambda_p t} - e^{-\lambda_d t})$$

Where:

A_d = activity of the daughter product due to decay of the parent
A_{po} = initial activity of the parent
T_p = half-life of the parent (years)
T_d = half life of the daughter (years)
λ_p = decay constant of the parent
λ_d = decay constant of the daughter
t = time interval of interest (years)

and

$$\lambda = 0.693 / t_{1/2}$$

Of particular interest to the assessment of potential impacts to groundwater, is the prediction of the radium-226 concentrations that may be present in the landfill in the future. Thorium-230 decays to radium-226 through alpha decay. As thorium-230 was detected at levels substantially higher than the other radionuclides detected at the landfill, with continued decay the levels of radium-226 will increase over time. The radioactive decay equation was used to predict both the decay of thorium-230 to radium-226 and the decay of radium-226 to radon-222 to estimate the level of radium-226 that will be present in the future.

The arithmetic average values of thorium-230 and radium-226 from all of the Area 2 samples were 2,140 and 189 pCi/g, respectively (Appendix A). These values were used in the equations presented above to estimate the average amount of radium-226 that would be present in Area 2 in 1,000 years. Accounting for the in-growth of radium-226 due to the decay of 2,140 pCi/g of thorium-230 results in an estimated radium-226 concentration of 749 pCi/g. During the same 1,000 years, the existing 189 pCi/g of radium-226 would decay to 123 pCi/g resulting in a total estimate concentration of radium-226 of 871 pCi/g after 1,000 years.

7.2.3 Other Fate and Transport Processes

In addition to radioactive decay, other fate and transport processes affect the concentrations of the various radionuclides that may remain at the landfill over time. Primary among these are sorption and volatilization.

7.2.3.1 Leaching and Sorption

Leaching is the process whereby materials in or attached to a solid phase are separated from the solid phase and are mobilized into a dissolved phase in water. Sorption is the process whereby a radionuclide becomes attached to the soil matrix. The partitioning of a particular radionuclide or for that matter any element or compound, between the soil or water phase can be estimated based on the distribution coefficient.

For example, the amount of a particular radionuclide that could leach from soil into groundwater can be estimated using the following equations (DOE, 1992):

$$C_{w_i} = \frac{C_{s_i}}{k_d * D_f}$$

Where:

C_{w_i} = groundwater concentration of constituent i (pCi/l for radionuclides);

C_{s_i} = soil concentration of constituent i (pCi/g for radionuclides);

k_d = distribution coefficient for constituent i (l/g); and

D_f = dilution factor between the unsaturated and saturated zones (unitless)

The dilution factor is determined from the following relationship:

$$D_f = 1 + \frac{V_d * t * CF}{I * X_l * n_e}$$

Where:

V_d = Darcy velocity in the saturated zone (cm/s)

t = thickness of the saturated zone (m);

CF = conversion factor (3.2×10^7 s/yr);

I = infiltration rate (cm/yr);

X_l = length of the contaminated zone parallel to the direction of groundwater flow; and

n_e = effective porosity of the unsaturated zone (m^3 / m^3)

The Darcy velocity in the saturated zone is determined from the following relationship (Freeze and Cherry, 1979):

$$V_d = K * i$$

Where:

K = hydraulic conductivity of the saturated zone (cm/s); and

i = hydraulic gradient of the saturated zone (m/m).

Published distribution coefficient values for radionuclides are generally quite high. Values for radium range from a low of approximately 500 L/kg for sandy soils to a high of approximately 36,000 L/kg for silty soils (Thibault, et al., 1990) such as those present at the landfill. As a result, radium as well as most of the radionuclides tends to strongly partition to the solid phase. As discussed above, review of the data indicates that the radionuclide occurrences at the West lake Landfill are consistent with this partitioning. That is, the radionuclides present in the soils associated with OU-1 strongly tend to remain in the soil or sediment phases rather than leaching to the water phases.

The following values were used in the above equations to estimate the groundwater concentration beneath the landfill that may occur after 1,000 years in the future, that is once the radium levels have increased significantly due to decay of thorium-230:

C_{s_i} = 871 pCi/g (from calculations presented above);

k_d = 36 L/g (for radium in silty soils);

V_d = 8.82×10^{-6} cm/s (0.025 ft/d);

t = 30.48 m (100 ft);

CF = 3.2×10^{7} s/yr;

I = 8.64 cm/yr (assumed to be 3.4 inches/yr or 10% of precipitation);

X_l = 275 m (900 ft which is approximately the length of Area 2 in the direction of groundwater flow); and

n_e = $0.25\ m^3 / m^3$

Use of these values results in an estimated radium-226 concentration in groundwater of 1.56 pCi/l. This value is similar to the maximum values observed in all of the groundwater samples. Based on this result, the maximum potential impacts are anticipated to occur under current conditions. As a conservative estimate, the 95% upper confidence limit of the arithmetic average values for throium-230 and radium-226 were also utilized for an evaluation of the potential future groundwater concentrations of radium-226. Using the upper 95% confidence limits results in an estimated average radium-226 concentration in Area 2 soils of 1,524 pCi/g. Using this value in the leaching calculation results in an estimated groundwater concentration of only 2.7 pCi/l in 1,000 years.

The groundwater concentrations estimated from these calculations are conservative because the concentration in the aquifer was identified for a point directly below Area 2 (i.e., the path length for flow within the aquifer was assumed to be zero) although the nearest existing well is located over one mile away. In addition, the initial leaching was assumed to occur as an equilibrium process, with the rate of desorption from soil to water equal to the rate of sorption (i.e., no hysteresis was included in the sorption-desorption process as is typically present). Furthermore, the concentration of radium-226 in the saturated aquifer was approximated by assuming the contaminated water would mix instantaneously and homogeneously with uncontaminated groundwater. The leaching calculations performed above are independent of time and simply indicate the concentration in groundwater that might eventually occur after 1,000 years. Actual concentrations would be lower due to sorption processes that would occur within the unsaturated zone that would further delay the leaching of radium to the underlying groundwater. In addition, in the presence of sulfate, which is naturally occurring to some degree in all soils and groundwaters and is typically elevated in landfill wastes and leachate, radium-226 will form radium-sulfate, a compound that is extremely insoluble. As a result, the estimated concentrations of radium-226 that may occur in the future are anticipated to be lower than any of the values that may be estimated using the equations presented in this section.

Similar calculations were performed for uranium. Thibault et al. (1990) report average values for the distribution coefficient for uranium of 35 L/Kg for sandy soil and 15 L/Kg for silts. Use of the geometric mean values for the Area 2 soil samples (1.85 pCi/g for uranium-238 and 2.15 pCi/g for uranium-234) results in estimated groundwater concentrations of approximately 3.4 to 8 pCi/L for uranium-238 and 4 to 9.3 pCi/L for uranium-234. These results are similar to the levels detected in the groundwater samples obtained during the RI.

7.2.3.2 Volatilization

Volatilization is the process whereby a chemical is transferred from a solid phase or from a dissolved phase in water to a gas or vapor phase. With the exception of the radon isotopes, the radionuclides present at the landfill are not volatile and will remain in the solid or liquid phase. For the radon isotopes, volatilization is an important fate and transport process. As radon is a gas, its primary fate will be to migrate to the atmosphere and become dispersed within the atmosphere.

8.0 NON-RADIOLOGICAL CHEMICAL OCCURENCES IN AREAS 1 AND 2

Although OU-1 is focused on occurrences of radiologically impacted materials in Areas 1 and 2, the purpose of the RI/FS as stated in the SOW is to investigate the nature and extent of contamination, which is defined as both radiological and other hazardous substances. Consequently, in the course of the field investigations and laboratory analyses conducted for OU-1, a portion of the samples were analyzed for organic and non-radiological inorganic constituents. The scope and extent of the investigation of non-radiological contamination was specified in the EPA approved RI/FS Work Plan (McLaren/Hart, 1994). This section describes the results of the sampling and analyses of non-radiological contamination within or near the boundaries of Areas 1 and 2.

8.1 Non-Radiological Constituents Detected in Soil Samples

The soil samples collected by McLaren/Hart as part of the soil boring program (McLaren/Hart, 1996h) were analyzed for the following non-radiological constituents:

- Priority pollutant metals and cyanide,
- Total petroleum hydrocarbons,
- Volatile organic compounds,
- Semi-volatile organic compounds, and
- Pesticides and poly-chlorinated biphenyls.

As part of the field investigation and laboratory analyses, 43 soil samples from 28 borings were analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides and poly-chlorinated biphenyls (PCBs) and total petroleum hydrocarbons (TPH). Twelve of these borings were located in Area 1 and sixteen were located in Area 2. Seventeen of the soil samples analyzed for organic compounds came from Area 1 borings and 23 came from Area 2 borings. There were also three field duplicates for a total of 43 soil samples analyzed for organic compounds. Of the 43 samples collected and analyzed for non-radiological constituents, fifteen were of surface soils including five from Area 1 and ten from Area 2.

In addition, 37 soil samples from 25 borings were analyzed for the twelve priority pollutant metals including antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, thallium, and zinc. In addition, cyanide analyses were also performed on these samples. Nine of these borings were located in Area 1 and sixteen were located in Area 2. Eleven of the soil samples analyzed for trace metals came from Area 1 borings and 23 came from Area 2 borings. There were also three field duplicates for a total of 37 soil samples analyzed for trace metals.

A complete summary of the results of the non-radiological analyses (both organic and inorganic) obtained from the surface and subsurface samples from Areas 1 and 2 is presented in Appendix B. Additional detailed information is contained in the "Soil Boring/Surface Soil Investigation Report" (McLaren/Hart, 1996h). The following subsections discussed the non-radiological compounds detected, the frequencies of detection, and the concentrations detected in the soil samples by chemical group.

8.1.1 Trace Metals Detected in Soil Samples

A summary of the trace metal analytical results for the Area 1 and 2 soil samples is presented on Table 8-1. A complete listing of the trace metal analytical results is presented on Table B-13 in Appendix B. Ten of the twelve trace metals analyzed for were detected in all or many of the soil samples. The most commonly detected trace metals were arsenic, chromium, copper, lead, nickel and zinc, which were detected in all or nearly all of the 37 samples analyzed for trace metals. Beryllium was detected in approximately half of the samples while cadmium and selenium were each detected in ten samples and mercury was detected in only four samples. Antimony was only detected in two samples and thallium was only detected in one sample. In addition, cyanide was only detected in two samples.

Several samples contained trace metals at levels of thousands of parts per million (ppm). Overall, trace metals were generally detected at levels of single digit to tens of parts per million. These concentrations are similar to the levels found in the background samples (Appendix B). The laboratory reported most of the trace metal analytical results as estimated values as the laboratory spike quality control sample results were outside of the control limits.

The highest trace metal levels were found in the following samples: WL-114 at 0-ft, WL-115 at 5-ft, WL-208 at 20-ft (the sample from the 5-gallon bucket), WL-209 at 0-ft, and WL-210 at 0 ft. These samples contained two or three metals with concentrations greater than ten times the background levels. These included lead with four samples greater than ten times background, copper and nickel with three samples each greater than ten times background, chromium with two samples and arsenic and zinc with one sample each greater than ten times background. The concentrations of trace metals detected in the Area 1 and 2 soil samples is described in more detail below.

8.1.1.1 Trace Metals in Area 1 Soil Samples

Comparison of trace metal analytical results for the Area 1 soil samples to the site-specific background concentrations (Appendix B) shows that all metals are present at one or more locations at concentrations above background. Comparison of the data shows that two borings contain substantially elevated concentrations above background (WL-114 and WL-115).

- The surface sample from boring WL-114 contained elevated concentrations of arsenic (220 ppm), beryllium (3.3 ppm), copper (2,300 ppm), lead (320 ppm), nickel (3,600 ppm) and selenium (250 ppm).

- The sample from 5 feet in boring WL-115 contained elevated chromium (280 ppm), lead (900 ppm), and zinc (560 ppm) concentrations. This sample also contained 1.1 ppm total cyanide.

8.1.1.2 Trace Metals in Area 2 Soil Samples

Comparison of trace metal analytical results for soil samples from Area 2 and the adjacent Ford Property to the site specific background concentrations shows that all metals are present at one or more locations at concentrations above background. Comparison of the data shows that four borings contain substantially elevated concentrations above background (WL-206, WL-208, WL-209 and WL-210).

- The surface sample from boring WL-206 contained elevated concentrations of beryllium (2.2 ppm), copper (160 ppm), lead (400 ppm), and zinc (400 ppm).

- The sample collected from 20 feet in boring WL-208 (the sample from the 5-gallon bucket) contained elevated chromium (890 ppm), lead (2,100 ppm), and zinc (1,100 ppm) concentrations. This sample also contained 0.62-ppm total cyanide.

- The surface sample from boring WL-209 contained elevated concentrations of arsenic (35 ppm), copper (360 ppm), lead (1,900 ppm), and nickel (680 ppm).

- The surface sample from boring WL-210 contained elevated concentrations of arsenic (14 ppm), copper (280 ppm), lead (2,200 ppm), nickel (660 ppm) and selenium (38 ppm).

These samples also contained some of other trace metals at levels only slightly greater than background. Samples other than the six described above may also have contained a few trace metals at levels slightly greater than background (Appendix B).

Of the 34 independent field samples (i.e. not counting the duplicate samples), the greatest number of exceedances of background levels were associated with copper (14), chromium (9), lead (9), and zinc (7). Lesser numbers of exceedances were associated with arsenic (5), nickel (5), and beryllium (3). Cadmium, mercury and selenium were not detected in any of the background samples and consequently site-specific background levels were not established. Cadmium was detected in eleven, mercury in four, and selenium in ten of the 43 samples.

8.1.2 Total Petroleum Hydrocarbons Detected in Soil Samples

A summary of the total petroleum hydrocarbon (TPH) analytical results is presented on Table 8-2. A complete listing of the trace metal analytical results is presented on Table B-14 in Appendix B. TPH analyses were performed on the 43 soil samples for gasoline, diesel and motor oil range hydrocarbon compounds. Gasoline range hydrocarbons were detected in six, diesel range hydrocarbons in four, and motor oil range hydrocarbons in twenty of the 43 samples. The highest concentrations of TPH were detected in the sample of the material in the 5-gallon bucket obtained from the 20-ft depth of boring WL-208.

Of the soil samples, the highest TPH levels were found in the samples obtained from the 15-ft depth of boring WL-210, the 16-ft depth in boring WL-230, and the 25-ft depth of boring WL-218. Lesser amounts of petroleum hydrocarbons, but still at levels above 100 ppm, were detected in the surface sample from boring WL-114 and samples from depths of 5-ft in borings WL-101 and WL-115 in Area 1. In Area 2, samples from the 15-ft depth in boring WL-208, 25-ft depth in boring WL-214, 43-ft in boring WL-226 and 40-ft in boring WL-227 all contain petroleum hydrocarbons at levels greater than 100 ppm. Additional discussions of hydrocarbon occurrences in Area 1 and 2 soil samples are presented below.

8.1.2.1 Petroleum Hydrocarbons in Area 1 Soil Samples

Petroleum hydrocarbons were detected in four borings WL-101, WL-106, WL-114, and WL-115 in Area 1. Detections of total petroleum hydrocarbons included:

- Gasoline range constituents were detected at the 5-foot depth in boring WL-115 at a concentration of 120 ppm. Diesel range hydrocarbons were also detected at 100 ppm in this sample.
- Diesel range constituents were detected in the surface sample from boring WL-114 at a concentration of 130 ppm.
- Motor oil range constituents were detected in three borings (WL-106 at 0-ft, WL-114 at 0-ft, and WL-115 at 5-ft) at concentrations ranging from 76 to 130 ppm.

8.1.2.2 Petroleum Hydrocarbons in Area 2 Soil Samples

Petroleum hydrocarbons were detected in Area 2 in 15 borings (WL-206, WL-208, WL-209, WL-210, WL-213, WL-214, WL-215, WL-218, WL-221, WL-222, WL-

226, WL-227, WL-230, WL-231, and WL-235). TPH detections in Area 2 soils included:

- Gasoline range constituents were detected in three borings at concentrations ranging from of 240 to 2,600 ppm.
- Diesel range constituents were detected in three borings at concentrations ranging from 51 to 310 ppm.
- Motor oil range constituents were detected in 15 borings at concentrations of 19 to 3,100 ppm.

Overall, the greatest levels of petroleum hydrocarbons detected in any of the soil samples were found in the sample from the five-gallon bucket obtained from the 20-foot depth in boring WL-208 and the soil sample obtained from the 15-foot depth in boring WL-210.

8.1.3 Volatile Organic Compounds Detected in Soil Samples

Volatile organic compounds (VOCs) were only detected in approximately three-quarters of the 43 soil samples (Table 8-3 and Table B-15 in Appendix B). The primary VOCs detected were aromatic hydrocarbons (toluene, xylenes, etc.) and ketones (acetone and 4-methyl 2-pentanone) and isolated occurrences of methylene chloride. With the exception of a few samples, the concentrations of the individual VOCs detected were less than one ppm. The majority of the VOC results were estimated values.

The one analysis that displayed high levels of VOCs was from the sample (WL-208 at 20 ft) of the contents of a severely damaged 5-gallon container that was brought up with the augers during drilling operations. In addition to containing gasoline and motor oil range hydrocarbons, this sample contained stained soil with benzene at 120 ppm, toluene at 8,300 ppm, ethylbenzene at 300 ppm, xylenes at 2,300 ppm, acetone at 1,400 ppm, methylene chloride at 240 ppm, and 1,1-dichloroethane at 270 ppm. All of these results were estimated values.

The highest levels of VOCs in a soil sample were found in the sample obtained from boring WL-210 at 15 ft which contained toluene (140 ppm) and xylenes (166 ppm) along with lesser amounts of ethyl benzene (32 ppm) and 2-butanone (50 ppm). All of these results were estimated values. A high level of 1,4-dichlorobenzene was detected in the soil sample obtained from the 16-ft depth from boring WL-230. In general, the samples with the highest detected levels of VOCs (WL-115, WL-208, WL-210, WL-218, and WL-230) corresponded with samples that also contained high levels of petroleum hydrocarbons.

8.1.4 Semi-Volatile Organic Compounds in Soil Samples

A summary of the results of the semi-volatile organic compound (SVOC) analyses obtained from Area 1 and 2 soil samples is presented on Table 8-4. A complete listing of the trace metal analytical results is presented on Table B-16 in Appendix B. The detected compounds included the polynuclear aromatic hydrocarbons (PAHs) naphthalene, 2-methlynaphthalene, pyrene, fluoranthene and phenanthrene. The naphthalene compounds are often associated with occurrences of fuel, oil or other petroleum products while the other PAH compounds detected may be associated with oil and fuel products but are also commonly found in conjunction with fires or fire debris as they can be a product of incomplete combustion.

Various phthalate esters (butyl benzyl phthalate, diethyl phthalate, di-n-butyl phthalate and di-n-octyl phthalate) were detected in a few of the samples. Bis(2-ethyl-hexyl) phthalate was detected in most of the soil samples. Phthalate esters are plasticizers that are used as additives in the manufacturing of plastic products to give the products greater or lesser degrees of flexibility or rigidity. Because of their ubiquitous presence in plastic products and the extensive use of plastic products in analytical laboratories and equipment, phthalate esters, in particular bis(2-ethyl-hexyl) phthalate, are common laboratory induced contaminants or artifacts.

The detected concentrations of phthalate esters varied substantially but these compounds were generally detected at levels of less than one to approximately ten parts per million. In WL-115 butyl benzyl phthalate was detected at 180 ppm. In WL-208 where the 5-gallon container containing liquid was encountered during drilling and the removed soil stained, elevated butyl benzyl phthalate (5,100 ppm) and bis(2-ethylhexl) phthalate (180 ppm) concentrations were detected.

In addition to the PAHs and phthalate esters, two phenol compounds (phenol and 4-methyl phenol) were also detected in a few of the soil samples with the highest levels found in the sample from the 15-ft depth of boring WL-210 and the 25-foot depth from boring WL-213. In addition, benzoic acid was also detected in three samples from Area 2 at levels from 0.15 to 0.79 ppm.

The compound 1,4-dichlorobenze, the analysis of which can be obtained from either the VOC or the SVOC fraction, was detected in SVOC analysis of several of the soil samples. With the exception of the sample obtained from the 16-ft depth from boring WL-230, which contained approximately 530 ppm, only very low levels of 1,4-dichlorobenzene estimated to range from 0.062 to 0.14 ppm were detected in the SVOC analysis. As a result of the generally low levels of 1,4-dichlorobenzene found in the soil samples combined with the higher detected limits obtained by the SVOC analysis, there is only a poor correlation between the VOC and SVOC results for 1,4-dichlorobenzene.

8.1.5 Pesticides and Poly-Chlorinated Biphenyls in Soil Samples

A summary of the pesticide and poly-chlorinated biphenyls (PCBs) analytical results in soils are presented on Table 8-5. A complete listing of the trace metal analytical results is presented on Table B-17 in Appendix B. Pesticide compounds including 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, dieldrin, endrin, beta-BHC, and Endosulfan I were detected at low levels, generally less than 0.01 ppm to less than 0.001 ppm (or one part per billion) in many of the soil samples. Three PCB aroclors (1242, 1248, and 1254) were detected in Areas 1 and 2. In Area 1, three borings (WL-113, WL-114, and WL-115) detected PCBs at concentrations ranging from 0.033 to 2.6 ppm. In Area 2, PCB aroclors were detected in seven of eight borings (WL-208, WL-209, WL-210, WL-214, WL-226, WL-227, and WL-230) at concentrations ranging from 0.017 to 1.6 ppm; in the eighth boring (WL-218) PCBs were detected at a concentration of 18 ppm. The samples with the greatest number of pesticide and PCB occurrences included WL-113 at 45 ft, WL-115 at 5 ft, WL-218 at 25 ft, WL-227 at 40 ft, and WL-230 at 16 ft. The highest levels of PCBs were detected in the 25-ft depth sample from boring WL-218 that contained Aroclor 1248 at a concentration of 18 ppm. In all of the other borings in which PCBs were detected, the detected concentrations were approximately 2 ppm or less.

8.2 Non-Radiological Constituents Detected in Erosional Sediments

Erosional sediment samples were collected and analyzed by McLaren/Hart for radiological and priority pollutant constituents of concern. Sediment samples collected by EMSI were only analyzed for radiological constituents in accordance with the EPA approved Amended Sampling and Analysis Plan (EMSI, 1997a). Sediment sample analytical results are tabulated in Appendix E.

Non-radiological constituents detected in the erosional sediment samples obtained from Area 1 included trace metals, motor oil range petroleum hydrocarbons, SVOCs, and pesticides. Detected constituents included the following:

- SVOCs were detected in sediment samples from three of the four sampling locations (Weirs 1, 2, and 3). The detected concentrations were less than 0.2 ppm, except for bis(2-ethylhexyl)phthalate, which ranged as high as 5.8 ppm.
- Pesticides were detected in sediment samples from three of the four sampling locations (Weirs 1, 2, and 3). The detected concentrations ranged from 0.00034 to 0.00082 ppm.
- Motor oil petroleum hydrocarbons were detected in three of the four sediment samples (Weirs 1, 2, and 3). The detected range was 50 to 580 ppm with the

highest concentration being detected in the sediment sample collected from Weir 2.

- Trace metal results were generally consistent in all four sediment samples. However, one sediment sample (Weir 2) indicated the presence of substantially higher copper (61 ppm) and nickel (130-ppm) concentrations.

Non-radiological constituents detected in the Area 2 erosional sediment samples included trace metals, motor oil range petroleum hydrocarbons, SVOCs, and pesticides. The detected compounds included the following:

- SVOCs were detected in one sediment sample (Weir 7). The detected concentrations ranged from 1.1 to 1.8 ppm.

- One pesticide was detected in one of the sediment samples (Weir 5). The detected concentration was 0.00025

- Motor oil petroleum hydrocarbons were detected in one of the five sediment samples (Weir 5). The detected concentration was 53 ppm.

- Trace metal results were generally consistent in all five sediment samples. However, one sediment sample (Weir 5) indicated the presence of substantially higher lead (60 ppm) and zinc (95-ppm) concentrations.

8.3 Non-Radiological Constituents Detected in Rainwater Runoff Samples

No trace metals or petroleum hydrocarbons were detected in any of the rainwater runoff samples.

Non-radiological constituents detected in the Area 1 rainwater runoff samples included two VOCs (ethylbenzene and xylenes) and one SVOC (2,4-dimethylphenol). These constituents were detected only in the sample collected from Weir 2. The detected VOC concentrations ranged from an estimated value of 2.2 parts per billion (ppb) to 13 ppb; the detected SVOC concentration was 75 ppb. No other priority pollutant constituents of concern were detected in the four rainwater runoff samples obtained in Area 2.

Review of analytical results for Area 2 rainwater runoff samples (Appendix D) indicates that none of the non-radiological constituents were present above detection limits.

8.4 Non-Radiological Constituents Detected in Surface Water Samples

Review of non-radiological analytical results for the North Surface Water Body (Appendix D) indicates that only one metal, lead, was detected in both the unfiltered and filtered samples at concentrations of 18 and 3.9 ppb, respectively. No other non-radiological constituents were detected in the sample from the North Surface Water Body.

No non-radiological constituents were detected in the Flood Control Channel samples.

8.5 Non-Radiological Constituents in Perched Water and Area 2 Seep

Five metals were detected in the perched water samples (arsenic, chromium, mercury, nickel, and zinc). The detected constituent concentrations ranged from non-detect to 97 ppb. All of the detected metals were below their respective maximum contaminant levels (MCLs). All sample reporting limits were below the MCLs also.

Two metals were detected in the Area 2 seep (lead and zinc). These metals were detected in only the unfiltered samples at concentrations of 17 ppb and 130 ppb, respectively. Both of these metals were detected at concentrations below their respective MCLs.

Petroleum hydrocarbon compounds in the diesel and motor oil range were detected in the perched water samples. The detected concentrations ranged from 1.3 to 14 ppm. Petroleum hydrocarbons compounds in the diesel and motor oil range were also detected in the Area 2 seep sample at concentrations of 0.47 and 0.48 ppm, respectively.

Aromatic and halogenated VOCs were detected in the perched water samples. Aromatic compounds detected included: benzene (2.0 to 2.8 ppb); toluene (2.2 to 55 ppb); ethylbenzene (6 to 47 ppb); xylenes (17 to 150 ppb); chlorobenzene (11 to 29 ppb); and 1,2-dichlorobenzene (4 ppb). Other VOCs detected included: 2-butanone (<25 to 2,100 ppb); 4-methyl-2-pentanone; acetone (22 to 1,200 ppb); and 1,2-dichloroethane (2 ppb).

Aromatic VOCs were also detected in the Area 2 seep sample, but no halogenated VOCs were detected in this sample. Aromatic VOCs detected included: benzene (2.2 ppb), chlorobenzene (78 ppb) and 1,4-dichlorobenzene (11 ppb).

Thirteen SVOCs were detected in the perched water samples. Of these, six SVOCs were detected in at least two of the three perched water samples analyzed for SVOCs. The detected compounds included: benzoic acid (<75 to 810 ppb); naphthalene (30 to 63 ppb); phenol (<30 to 140 ppb); 4-methyl phenol (3.6 to 310 ppb); di-n-octyl phthalate (4.2 to 60 ppb); and bis(2-ethylhexl) phthalate (30 to 260 ppb).

Two SVOCs were detected in the Area 2 seep sample. These compounds were 1,4-dichlorobenzene (6.5 ppb) and 2,4-dimethylphenol (75 ppb).

Eight pesticides were detected in one or more of the perched water samples. The detected concentrations ranged from 0.015 to 0.18 ppb. Two PCB aroclors were also detected in the unfiltered samples. PCB aroclor 1242 was detected in the perched water sample obtained from boring (WL-231) at a concentration of 290 ppb. PCB aroclor 1248 was detected in the perched water sample obtained from boring (WL-219) at a concentration of 3.4 ppb. No pesticides or aroclor PCBs were detected in the Area 2 seep sample.

Perched water exhibited many of the conditions indicative of landfill leachate: total dissolved solids (TDS) ranged from 2,300 to 6,300 ppm; total suspended solids (TSS) ranged from 1,500 to 6,000 ppm; chloride concentrations ranged from 510 to 1,500 ppm; the chemical oxygen demand (COD) ranged from 690 to 1,400 ppm; the biological oxygen demand (BOD) ranged from <300 to 460 ppm; and the ammonia concentration ranged from 93 to 220 ppm.

The Area 2 seep sample had a similar TDS concentration of 2,000 ppm; however, all of the other landfill leachate indicator parameters were detected at lower concentrations.

8.6 Non-Radiological Constituents Detected in Groundwater Samples

McLaren/Hart obtained groundwater samples from 30 wells for non-radiological analyses. These samples included twelve shallow wells, ten intermediate depth wells, and eight deep alluvial wells (Appendix C). McLaren/Hart performed two rounds of groundwater sampling during which non-radiological analyses were obtained. Both filtered and unfiltered samples were collected during the first round of sampling in November 1995. Only filtered samples were obtained for non-radiological analyses during the second round in February 1996. The third round of groundwater sampling performed by McLaren/Hart along with the ASAP sampling performed by EMSI were only analyzed for radiological constituents.

The groundwater samples were analyzed for thirteen trace metals including: antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, and zinc. Eight metals were detected in the groundwater samples and are discussed below. These metals were detected in both the unfiltered and filtered samples with the detected concentrations being generally similar, but slightly higher for the unfiltered samples. The five metals that were not detected in any of the groundwater samples were antimony, beryllium, cadmium, silver and thallium. The groundwater samples were also analyzed for cyanide, but this compound was not detected in any of the groundwater samples.

Results of the groundwater analyses for trace metals are summarized on Table 8-6. A complete summary the analytical results obtained from the groundwater samples is presented in Appendix C. The following is a narrative summary of the trace metals detected in the groundwater samples.

- Arsenic was detected in about half the samples at concentrations ranging from 10 to 420 parts per billion (ppb). Arsenic was detected at concentrations above 50 ppb in only four wells (S-10, S-84, MW-F3, and D-14).

- Chromium was detected in about a third of the wells at concentrations ranging from 10 to 62 ppb. Chromium was generally only detected in the unfiltered samples. It was detected in filtered samples in only two wells (S-5 and S-10) at concentrations ranging from 11 to 22 ppb.

- Copper was only detected in six wells and only in the unfiltered samples obtained from these wells. The detected concentrations range from 23 to 76 ppb.

- Lead was detected in almost all unfiltered samples at concentrations ranging from 3.1 to 70 ppb. Lead was detected in only two filtered water samples (S-5 and I-4) at concentrations ranging from 4.1 to 7.9 ppb.

- Mercury was detected in only one unfiltered groundwater sample (D-14) at a concentration of 0.21 ppb.

- Nickel was detected in about a third of the wells at concentrations ranging from 21 to 110 ppb. Nickel was most frequently detected in the unfiltered samples and only four wells contained nickel in both the unfiltered and filtered samples (S-5, S-82, D-12, and D-83).

- Selenium was detected in only one well (MW-101) on one occasion at a concentration of 38 ppb.

- Zinc: This constituent was detected in most unfiltered samples at concentrations ranging from 28 to 310 ppb. Zinc is only detected in six filtered samples (S-1, S-5, S-82, I-11 D-83, and D-93) at concentrations ranging from 20 to 77 ppb.

In addition to the limited occurrences of trace metals detected in groundwater, with the exception of arsenic, trace metals generally were only detected in the unfiltered samples of groundwater. The presence of a trace metal in an unfiltered sampled can be due to either the actual presence of the trace metal in the dissolved phase and/or the presence of fine-grained soil material that is not filtered out by the well screen/sand pack. Consequently, the representativeness of trace metal occurrences in unfiltered groundwater samples is questionable. Therefore, only the areal distribution of arsenic could be examined.

The majority of the arsenic results were either non-detect or similar to the levels found in upgradient well S-80 (see Table C-13 in Appendix C). The highest levels of arsenic were detected in shallow well MW-F3 located near the southeast corner of Area 2 (see Figure 4-12) where in November 1995 arsenic was detected at 420 ug/L (ppb) in the unfiltered (total) sample fraction and 400 ug/L in the dissolved (filtered) fraction. None of the wells located near well MW-F3 contained elevated levels of arsenic. The second highest level of arsenic (49 dissolved and 94 ug/L total) was detected in deep well D-14 located along the southern portion of Area 1. None of the other wells located near well D-14 displayed elevated levels of arsenic. The remaining occurrences of arsenic were either at or just slightly above background and were less than the drinking water standard of 50 ug/L. It should be noted that none of the groundwater samples obtained from wells located along the northern or western boundary of Area 2 contained detectable levels of arsenic. Therefore, arsenic does not appear to be migrating offsite from the West Lake Landfill. In addition, review of the arsenic occurrences in the various well clusters indicates that although arsenic may be present in the shallow alluvial groundwater, it is generally not detected in the intermediate or deeper portions of the alluvial groundwater system beneath Area 2.

Petroleum hydrocarbons in the diesel and motor oil range were detected in six wells (S-5, S-8, I-11, I-65, D-14 and D-85). The detected concentrations ranged from 0.53 to 3.5 parts per million (ppm) (Table 8-7). The distribution of the few monitoring wells that contained detectable levels of petroleum hydrocarbons does not indicate any discernable pattern.

Volatile organic compounds (halogenated and aromatic) were detected in about half the wells. Eleven compounds were detected in the groundwater samples (Table 8-8) including:

- Benzene was detected in three wells (I-2, I-9 and D-93) at concentrations ranging from 5.6 to 11 ppb.

- Toluene was detected in one well (S-5) at concentrations of 19 and 45 ppb.

- Ethylbenzene was detected in two wells (S-5 and D-14) at concentrations ranging from 13 to 22 ppb.

- Xylenes were detected in two wells (S-5 and D-14) at concentrations ranging from 19 to 78 ppb.

- Chlorobenzene was detected in four wells (S-84, MW-F3, PZ-114-AS and D-14) at concentrations ranging from 6.0 to 170 ppb.

- 1,2-Dichlorobenzene was detected in two wells (S-5 and MW-F3) at concentrations ranging from 5.1 to 8.1 ppb.

- 1,4-Dichlorobenzene was detected in three wells (S-5, MW-F3, and D-14) at concentrations ranging from 9.9 to 50 ppb.

- Cis-1,2-Dichloroethylene was detected in three wells (S-10, S-82, and D-14) at concentrations ranging from 7.2 to 34 ppb.

- 1,1-Dichloroethane was detected in one well (D-13) at concentrations ranging from 7.6 to 8.0 ppb.

- 2-Butanone was detected in only one well (D-12) on one occasion at a concentration of 70 ppb.

- Acetone was detected in three wells (I-11, D-13 and D-14) during the November 1995 sampling round, but not confirmed during the February 1996 sampling round. The detected concentrations ranged from 37 to 44 ppb.

Due to the limited number of locations containing detectable levels of volatile organic compounds, no discernable pattern could be identified.

Semi-volatile organic compounds (Table 8-9) were detected in six wells (MW-F3, I-11, I-62, D-3, D-12, and D-14). The compounds detected were 1,4-dichlorobenzene, 4-methylphenol, di-n-octyl phthalate, and bis(2-ethylhexyl)phthalate and the detected concentrations ranged from 12 to 290 ppb. The only compound detected during both sampling rounds was 1,4-dichlorobenzene (18 to 38 ppb) in D-14. The compound 1,4-dichlorobenzene was also detected using USEPA Method 8240 for VOCs. The compound 1,4-dichlorobenzene was also detected in the two samples from this well by the SVOC analytical method (USEPA Method 8270). Concentrations detected by the SVOC analytical method were equal to or less than the concentrations reported by the VOC (USEPA Method 8240) analytical method. Due to the extraction procedure in the semi-volatile organic compound analysis, it is possible that some of the 1,4-dichlorobenzene was lost; therefore, the results of the VOC analytical method may be more reliable.

Three pesticides were detected during the November 1995 sampling round but not confirmed during the February 1996 sampling . The three pesticides detected were 4,4-DDD, aldrin, and lindane. The detected concentrations ranged from 0.011 to 0.11 ppb Table 8-10). No PCB aroclors were detected in any of the groundwater samples.

9.0 BASELINE RISK ASSESSMENT

A Baseline Risk Assessment (BRA) for Operable Unit 1 has been prepared by Auxier & Associates (Auxier) in coordination with EMSI on behalf of the OU-1 Respondents. The BRA is included as Appendix A of this RI report. This section of the RI presents a brief summary of the results and conclusions reached by Auxier as presented in the BRA. Specifically, this section of the RI presents a summary of the following BRA tasks:

- Selection of Chemicals of Potential Concern
- Exposure Assessment
- Toxicity Assessment
- Risk Characterization
- Uncertainty Assessment
- Ecological Assessment

The first five of these tasks are part of the evaluation of potential risks to human health. The final task is an assessment of potential impacts to possible ecological receptors that may be present at or near the landfill.

9.1 Human Health Evaluation

A quantitative assessment of potential risks to human health was developed by Auxier in accordance with EPA's guidance for human health risk assessments (EPA, 1989). This assessment included the following:

- Identification of Chemicals of Potential Concern (CoPCs);
- Evaluation of potential exposure scenarios;
- Assessment of the toxicity associated with the radiological and non-radiological CoPCs present in OU-1;
- Characterization of the potential risks to human health posed by the CoPCs in OU-1; and
- Discussion of the uncertainties associated with the risk characterization effort.

9.1.1 Chemicals of Potential Concern

The first step in the risk assessment process is to identify the CoPCs for which the associated potential risks will be assessed. Contamination at the landfill consists of two localized areas containing radioactive materials associated with naturally occurring uranium-238, uranium-235, and thorium-232 decay series. The radionuclides with relatively long half-lives were selected as indicators of all of the members of the three radioactive decay series and used as radiological CoPCs. In addition, as with any solid waste landfill, organic and inorganic chemicals are present within the solid waste materials. Based upon an evaluation of the concentrations and toxicity of the organic and inorganic chemicals detected in the landfill materials, Auxier identified non-radiological CoPCs. The radiological and non-radiological CoPCs selected by Auxier for consideration in the human health risk assessment are summarized on Table 9-1.

9.1.2 Exposure Assessment

The potential for health effects from exposure to site-related contaminants were estimated for potential current and possible future receptors located onsite and in offsite areas potentially affected by releases from OU-1. Based upon an assessment of the characterization data describing the source term, existing access controls, and the current and projected future land uses, hypothetical receptor scenarios were selected for risk characterization. These potential receptors included a landfill groundskeeper working adjacent to Areas 1 and 2 (current), an onsite groundskeeper working on Areas 1 and 2 (future), and an offsite (buffer zone or Crossroad property) groundskeeper (both current and future). As no maintenance activities are currently being conducted in Areas 1 and 2, potential exposures to an onsite groundskeeper were not evaluated under the current exposure scenario. Other possible future exposure scenarios evaluated in the BRA included a possible adjacent building user that either uses Areas 1 or 2 for parking or for open storage uses associated with the adjacent building (future). Residential receptors anywhere on the landfill or commercial building users or construction workers on Areas 1 and 2 were not evaluated due to existing deed restrictions on current and future land uses that restrict these uses.

The physical characteristics of the Site and postulated receptor behavior were used to identify potential exposure pathways to the hypothetical receptors. The potential exposure scenarios identified by Auxier for evaluation in the risk assessment included the following:

- Exposure to external radiation;
- Inhalation of dust and gas;
- Dermal contact; and

- Incidental ingestion of soil.

These hypothetical exposure pathways were combined with the results of the toxicity assessment to characterize the potential risks posed by OU-1.

9.1.3 Toxicity Assessment

The toxicity assessment determined the mode of toxicity of the various CoPCs, that is carcinogenic and systemic toxicity, and provided a quantitative measure of the toxicity. Toxicity profiles including carcinogenic slope factors and chemical reference doses were developed for each of the CoPCs.

9.1.4 Risk Characterization

Maximum credible risks were calculated for hypothetical current receptor scenarios including a groundskeeper performing maintenance activities adjacent to Areas 1 and 2 and a groundskeeper on the adjacent Ford property. The carcinogenic risks to each of these hypothetical receptors were estimated to be within the generally acceptable EPA target risk range of 10^{-6} to 10^{-4} (Table 9-2). The dominant exposure pathway for these receptors was determined to be external radiation exposure from radionuclides in soil. No adverse systemic toxic effects resulting from the presence of non-radionuclide constituents were indicated by this assessment.

The Ford property groundskeeper and the onsite groundskeeper working in Areas 1 and 2 receptor scenarios were also evaluated under projected future conditions. The results of the baseline risk assessment indicated that potential risks to onsite and offsite receptors, represented by the groundskeeper working in Areas 1 and 2 and the Ford property groundskeeper scenarios, were estimated to be 6×10^{-5} for Area 1, 2×10^{-4} for Area 2 and 2×10^{-6} for the Ford property. With the possible exception of the future groundskeeper that may work on Areas 2, the calculated risks for the future groundskeeper scenarios were within EPA's target risk range of 10^{-4} to 10^{-6}.

The evaluation of potential risks that might be posed to a user of a building constructed outside of, but adjacent to Areas 1 or 2 that may use Areas 1 or 2 for parking indicated that credible risks are expected to be within the generally acceptable EPA target risk range of 10^{-6} to 10^{-4}. The potential risk to a future worker who may be involved in outdoor storage activities in Areas 1 and 2 was estimated at 1×10^{-4} for Area 1 and 4×10^{-4} for Area 2. Nearly all of the potential risk associated with this scenario is due to possible external radiation exposure.

Non-radiological contaminants are unlikely to cause an unacceptable risk to human health under future conditions for any of the onsite receptor scenarios evaluated. Adverse systemic (non-carcinogenic) health effects are not expected, as the calculated hazard indices for non-radiological CoPCs were significantly less than one.

9.1.5 Uncertainty Assessment

The purpose of the uncertainty assessment is to identify those types of input to the risk assessment that have the greatest potential to affect the results, and evaluate the relative potential impact of those inputs on the results of the risk assessment. The areas of uncertainty identified for the OU-1 risk assessment include the following:

- Definition of the location and extent of the radiological materials;
- Characterization of the radiological source term;
- Measured or estimated quantities and concentrations;
- The conceptual model for OU-1;
- Calculations, models and numerical parameter values used for OU-1; and
- Areas, factors or other items for which limited or no information are available.

The relative potential impact of these uncertainties on the results of the risk assessment and the projected direction (conservative, that is tending to over-estimate the projected risks, or liberal, that is to under-estimate the potential risks) of the bias introduced by the identified uncertainties were estimated for the risk assessment. The results of these estimates are summarized on Table 9-3. Overall, it was concluded that the estimates of potential human health risks were conservative, that is the evaluations tended to over-estimate the potential risks to human health.

9.2 Ecological Evaluation

The BRA also included a screening level ecological assessment. Consistent with EPA guidance (EPA, 1997), the ecological assessment used a phased approach to evaluate the potential risks to ecological receptors potentially exposed to chemicals in environmental media associated with OU-1. During the initial step, problem formulation was used to define the scope of the risk assessment. Based on the results of the problem formulation phase, it was concluded that terrestrial ecological receptors may be exposed to chemical contaminants in various environmental media including soils, surface water and air.

Exposures to representative wildlife species via the various pathways were estimated and the total daily exposure was calculated for each receptor species. Based upon a comparison of these intakes to toxicity information, it was determined that contaminants present in OU-1 may have an adverse effect upon the environment (Table 9-4). Plants, soil invertebrates such as earthworms, small wildlife species and mammalian predators may be adversely impacted as a result of exposure to the contaminants including the metals arsenic, cadmium, chromium, copper, lead, selenium, and uranium present in the surface and near-surface soils.

Although the results of the ecological risk assessment indicate that a potential impact to wildlife may exist, the conservative nature of the risk assessment assumptions undoubtedly result in an over-estimate of the actual risks that may be posed by Areas 1 and 2. One of the most significant sources of uncertainty potentially contributing to an over estimate of the possible risks to ecological receptors is the use of the maximum detected value as the basis for the exposure concentration. For example, the majority of the estimated risks calculated for Area 1 result primarily from selenium and to a lesser extent nickel and chromium. Occurrences of high levels of these metals are associated with a single sample result, the surface sample obtained from boring WL-114. This sample contained selenium and nickel levels of 250 and 3,600 ppm respectively, which are substantially greater than the levels found in any of the other samples. Using the second highest levels detected for each of these contaminants, 1.8 and 73 ppm respectively, which are still substantially greater than all of the other sample results, yields substantially lower estimates of potential risk. Consequently, the calculated potential chemical risks are highly influenced by a few elevated trace metal results, that are not representative of the overall trace metal levels detected in the surface or near surface soils. As a result, the potential risk estimates calculated using the maximum values are only representative of the potential risks at a single sample location, and thus are extremely conservative and greatly overestimate the risks that may be present at the other locations in Areas 1 and 2.

It should also be noted that the areas of potential impact to wildlife are located within the landfill boundaries. Some of the ecosystems present at the West Lake Landfill are the result of existing institutional controls and other limitations on land-use within OU-1 which allow field succession to take place. As a result, any disturbance of the Areas 1 and 2, such as might occur with remediation activities, may significantly alter or destroy the habitats that currently exist, forcing wildlife present at the West Lake Landfill to migrate to other areas. In addition, increasing development of the land around the landfill has removed, and will continue to remove, significant amounts of wildlife habitat. This overall decrease in habitat area over time will result in some larger species leaving the area and reducing the overall ability of the area to support some types of wildlife.

Table 9-1 : Chemicals of Potential Concern (CoPCs) for Human Health Risk Assessment

<u>Radiological CoPCs</u>

Uranium-238 (for uranium-238 and 2 daughters)
Uranium–234
Thorium-230
Radium-226
Lead-210

Uranium-238 + Uranium-234 / 2 * 0.05 (for Uranium-235 and one daughter)
Protactinium-231

Thorium-232

<u>Non-Radiological CoPCs</u>

Arsenic
Lead
Uranium

Aroclor 1254

Table 9-2: Summary of Calculated Risks for Current and Future Potential Receptors

Potential Receptor	Location	Radionuclide Cancer Risk	Chemical Cancer Risk	Total Cancer Risks	Hazard Quotient
Current Scenarios					
Grounds keeper adjacent to Area 1	Onsite	1×10^{-5}	NE	1×10^{-5}	NE
Grounds keeper adjacent to Area 2	Onsite	4×10^{-5}	NE	4×10^{-5}	NE
Ford property grounds keeper	Onsite	6×10^{-7}	NE	6×10^{-7}	NE
Future Scenarios					
Area 1 grounds keeper	Onsite	6×10^{-5}	2×10^{-7}	6×10^{-5}	0.0059
Area 2 grounds keeper	Onsite	2×10^{-4}	3×10^{-8}	2×10^{-4}	0.0022
Area 1 Adjacent Building User	Onsite	1×10^{-5}	NE	1×10^{-5}	NE
Area 2 Adjacent Building User	Onsite	4×10^{-5}	NE	4×10^{-5}	NE
Area 1 Storage Yard Worker	Onsite	1×10^{-4}	NE	1×10^{-4}	NE
Area 2 Storage Yard Worker	Onsite	4×10^{-4}	NE	4×10^{-4}	NE
Ford property grounds keeper	Offsite	2×10^{-6}	NE	2×10^{-6}	NE

NE = No exposure anticpated because a complete exposure pathway does not exist.

Table 9-3: Uncertainties Associated with Estimated Human Health Risks for OU-1

Source of Uncertainty	Potential Impact on Estimated Risks	Impact on Health Protectiveness
Extent of OU-1 areas	Low	Increases Protectiveness
Heterogeneity of waste form	High	Increases Protectiveness
Bias in sampling	High	Increases Protectiveness
Inclusion of natural background	Low to moderate	Increases Protectiveness
Calculation of 95% UCL	Moderate	Increases Protectiveness
Current and future land use as commercial/industrial	None	None
Current and future receptors as occupational	None	None
Source release and environmental transport mechanisms	Low	None
Radon release model	Low	Increases Protectiveness
Future receptor exposure mechanisms at points of contamination	Low	None
Approximating exposure with simplified expressions	Moderate to high	Increases Protectiveness
Change in individual parameter values	Low to moderate	Generally increases Protectiveness
Slope factors and reference doses	High	Increases Protectiveness
No reference doses for some contaminants	Moderate to high	Decreases Protectiveness
External exposure source geometry	Moderate	Increases Protectiveness
Representative contaminant concentrations	Moderate	Increases Protectiveness

Table 9-4: Summary of Estimated Ecological Risks for Operable Unit 1

Receptor	Hazard Quotients[1]	Primary Contributors[2]
Area 1		
Plants	547	Selenium and nickel
Invertebrates	152	Arsenic, chromium, copper, mercury, nickel and selenium
White-footed mouse	3,320	Selenium, arsenic and copper
Cottontail rabbit	5,750	Selenium, arsenic and copper
American Robin	16,000	Selenium, copper and cadmium
Area 2		
Plants	347	Uranium, chromium and lead
Invertebrates	144	Chromium
White-footed mouse	647	Selenium, lead and arsenic
Cottontail rabbit	1,700	Selenium and arsenic
American Robin	15,300	Selenium, lead, cadmium and chromium
Areas 1 and 2		
Red fox	154	Cadmium, selenium and arsenic
American woodcock	442	Lead and selenium
Red-tailed hawk	12.2	Selenium

1. As discussed in the text, the hazard quotients presented above are considered over-estimates of the potential risks.

2. These compounds were identified in the Baseline Risk Assessment as the primary contributors of risk to each of the potential receptor scenarios identified above. Occurrences of other chemicals present in OU-1 and 2 may also result in potential risks greater than the threshold values.

10.0 SUMMARY AND CONCLUSIONS

This section summarizes the site conditions at the West Lake Landfill and presents a revised conceptual model of the occurrence of radiologically-impacted materials and the potential pathways through which radionuclides have or could migrate from Areas 1 and 2. This section also presents a summary of the potential risks posed by the both the radionuclides and the non-radiological compounds present in and potentially migrating from Areas 1 and 2.

10.1 Summary of Site Conditions

This section presents a general summary of the surface and subsurface conditions at the West Lake Landfill.

10.1.1 Surface Setting

The West Lake Landfill is situated on the eastern edge of the Missouri River floodplain approximately two miles east of the river. The river is separated from the area of the West Lake Landfill by a levee system.

Ground elevations at the West Lake Landfill range from approximately 450 to 500 feet; however, the topography of the West Lake Landfill area has been significantly altered by quarry activities in the eastern portion of the landfill, and by placement of mine spoils and landfill materials in the eastern and western portion of the landfill.

Area 1 is situated on the north and western slopes of a topographic high within the landfill. Ground surface elevation varies from 490 feet on the south to 452 feet at the roadway near the landfill property entrance.

Area 2 is situated between a topographic high of landfilled materials on the south and the Ford property on the north. The topographic high in this area is about 500 feet on the southwest side of Area 2 sloping to approximately 470 feet near the top of the landfill berm along the south side of the Ford property. The upper surface of Area 2 is located approximately 20 to 30 feet above the adjacent Ford property and approximately 30 to 40 feet higher than the water surface in the flood control channel located to the southeast of Area 2. A berm on the northern portions of Area 2 controls runoff to the adjacent properties.

Surface runoff from Area 1 ultimately flows north to a drainage ditch, east to the drainage ditch on the southwest side of St. Charles Rock Road and then north to a surface water body within the drainage system and north of Area 2. Runoff from Area 2 generally flows into an internal closed topographic depression within Area 2. Some of the southern part of Area 2 drains into on-site drainage ditches that route the water to the St. Charles Rock Road drainage system. A very small area drains through a breach in the landfill berm for a limited distance onto the Ford property. No runoff from Area 2 flows into the flood control channel.

Land use in the area surrounding the landfill is commercial and industrial. Deed restrictions have been recorded against the entire West Lake Landfill to prevent residential development or groundwater use from occurring at the landfill. Additional deed restrictions have been recorded against Areas 1 and 2 to prevent construction of buildings or utility excavations in these areas. The southernmost portion of the landfill property is permitted for active sanitary landfill operations (Permit No.118912).

The property to the north of the landfill, across St. Charles Rock Road, is moderately developed with commercial, retail and manufacturing operations. The Earth City industrial park is located adjacent to the landfill on the west, across Old St. Charles Rock Road. The nearest residential development, "Spanish Village", is located to the south of the landfill near the intersection of St. Charles Rock Road and I-270 approximately ¾ mile from Area 1 and 1 mile from Area 2. Mixed commercial, retail, manufacturing and single family residential uses are present to the southeast of the landfill. The land use zoning for the West Lake Landfill and surrounding area is shown on Figure 3-4.

Three types of plant communities were identified in Areas 1 and 2. These include old field and hydrophilic plant communities identified in both Areas 1 and 2 and a forest plant community identified in Area 2 only. A fourth plant community, a maintained field community, was identified in areas adjacent to the landfill. These areas are maintained by mowing at frequency of at least once per year. No sensitive species or communities are known to occur on the immediate landfill or surrounding area.

10.1.2 Subsurface Setting

The geology of the landfill area consists of Paleozoic age sedimentary rocks overlying Pre-Cambrian age igneous and metamorphic rocks. The Paleozoic bedrock is overlain by unconsolidated alluvial and loess deposits of recent (Holocene) age.

The uppermost bedrock units in the vicinity of the landfill consist of Mississippian age limestone and dolomite with inter-bedded shale and siltstone layers of the Kinderhookian, Osagean, and Meramecian Series. The Kinderhookian Series is an undifferentiated limestone, dolomitic limestone, shale and siltstone unit ranging in thickness from 0 to 122 feet in the St. Louis area. The Osagean Series consists of the Fern Glen Formation, a red limestone and shale, and the Burlington-Keokuk Formation, a cherty limestone. The Fern Glen Formation ranges in thickness from 0 to 105 feet and the Burlington-Keokuk Formation ranges from 0 to 240 feet thick in the St. Louis Area.

Groundwater is present in both the bedrock units and the unconsolidated materials. The major bedrock aquifers of the St. Louis area include the Cambrian-age Potosi Dolomite and the Ordovician-age Gasconade Dolomite, Roubidoux Formation and St. Peter Sandstone.

The Potosi Dolomite can be up to 324 feet thick and occurs at an average depth of 2,240 feet in the St. Louis area. The Gasconade Dolomite and the associated Gunter Sandstone occur in thickness of up to 280 feet in the St. Louis area. These units are overlain by the Roubidoux Formation that ranges from 0 to 177 feet thick in the St. Louis area. The average depth of the Roubidoux Formation is approximately 1,930 feet. The St. Peter Sandstone lies at a depth of approximately 1,450 feet below ground surface and can be as much as 160 feet thick. Due to their depth, these formations are generally not used as a source of potable water. The deeper Cambrian and Ordovician-age aquifers are separated from shallower units by the Ordovician-age Maquoketa shale that appears to provide confinement for the underlying deeper aquifers.

Alluvial deposits of varying thickness are present beneath Areas 1 and 2. The landfill debris varies in thickness from 5 to 56 feet, with an average thickness of approximately 36 feet in Area 1 and approximately 30 feet in Area 2. The underlying alluvium increases in thickness from east to west beneath Area 1. The alluvial thickness beneath the southeastern portion of Area 1 is less than 5 feet (bottom elevation of 420 feet AMSL) while the thickness along the northwestern edge of Area 1 is approximately 80 feet (bottom elevation of 370 feet AMSL). The thickness of the alluvial deposits beneath Area 2 is fairly uniform at approximately 100 feet (bottom elevation of 335 feet AMSL).

During the RI investigations, groundwater was generally encountered in the underlying alluvium near or immediately below the base of the landfill debris. Isolated bodies of perched water were encountered in two of the 24 soil borings drilled in Area 1 and six of the 40 soil borings drilled in Area 2 as part of the RI field investigations. The perched water generally occurs in small isolated units at depths varying from five to 30 feet below ground surface.

Monthly groundwater levels measured in various landfill wells indicate that groundwater generally occurs only in the underlying alluvium at or below the base of the landfill materials with the exception of the localized perched water conditions encountered in isolated areas within the landfill. Groundwater elevations varied seasonally and were generally lowest during the fall and winter months (September through March) and highest during the spring and summer months (April through August).

The RI data indicate that only a very small amount of relief (less than one foot) exists in the water table surface beneath the landfill. Based on the water level data, the inferred direction of groundwater flow beneath Area 1 is to the south toward the active landfill.

No public water supply wells that obtain water from the alluvial aquifer are present near the landfill. The distribution of private wells in the vicinity of the West Lake Landfill is as follows:

- Four wells are located less than one mile from the landfill; however, two no longer exist and the remaining two are not used as drinking water sources;

- Seventeen wells located between one and two miles from the landfill including four wells used for irrigation purposes, one well at an abandoned site, and twelve wells used as drinking water sources; and

- Five wells located between two and three miles from the landfill, all of which are used as drinking water sources.

The nearest well reportedly used as a drinking water source is located approximately 5,300 feet to the north of the landfill (Foth & Van Dyke, 1989). The number of private wells has likely decreased since preparation of the Foth & Van Dyke, 1989 report due to urban and suburban development and flooding of some of the areas in 1993 and 1995.

10.2 Radiologically Impacted Materials

Radionuclides are present in a dispersed manner throughout the upper part of the landfill deposits in Area 1 and Area 2. Approximately 50,700 square feet (1.16 acres) of Area 1 has radionuclides exposed at the surface (upper 6 inches). Based on a thickness of six inches, the quantity of these surficial materials is estimated to be 900 cubic yards. Approximately 194,000 square feet (4.45 acres) of Area 1 have radionuclides present in the subsurface at depths ranging up 7 feet, with localized intervals present to depths of 15 feet. The quantity of subsurface impacted soils and associated materials including refuse, debris and fill materials is estimated at 23,500 cubic yards based upon an average thickness of 3.3 feet. The total volume of radiologically impacted materials in Area 1 is approximately 24,400 cubic yards.

Radionuclides are exposed at the surface over approximately 468,700 square feet (10.76 acres) of Area 2. The quantity of these surficial materials is estimated to be approximately 8,700 cubic yards. An additional 17,200 square feet in the northeastern portion of Areas 2 contains soil/sediment eroded from the surface of Area 2. Approximately 320 cubic yards of radiologically impacted materials is present in this area. Radionuclide impacted materials are present in the subsurface beneath approximately 817,000 square feet (18.76 acres) of Area 2 at depths of up to approximately 12 feet, with some localized deeper intervals. The quantity of subsurface impacted soils and associated materials including refuse, debris and fill materials in Area 2 is estimated to be 109,200 cubic yards based upon an average material thickness of 3.6 feet. The total volume of radiologically impacted materials in Area 2 is approximately 118,000 cubic yards. An additional 196,000 square feet of impacted materials are present in the southern portion of the Ford property, immediately north of Area 2. Based on a 6-inch thickness, these materials represent an additional 3,600 cubic yards.

The total estimated area underlain by radiologically impacted materials in Areas 1 and 2 is approximately 28 acres. The total estimated volume of radiologically impacted materials, including the refuse and unimpacted soils that are presented in the same depth interval and are co-mingled with the radiologically impacted materials is estimated to be 146,000 cubic yards.

There are three locations where relatively higher levels of radioactivity are present. The first of these is in Area 1 and includes the area just to the southeast of the facility access road and the Bridgeton Landfill office building extending from approximately boring WL-106 to boring WL-114 and continuing to the east to PVC-38. In Area 2, two locations with relatively higher radioactivity were identified. These include an area around borings WL-209, WL-226, PVC-4, PVC-6, PVC-7, PVC-19, and PVC-35 in the north-central portion of Area 2, and an area extending from approximately borings WL-234, PVC-10, and PVC-11 to borings WL-210 and WL-216 in the southern portion of Area 2.

In general, the isotope values above reference levels originated from radionuclides from the uranium-238 and uranium-235 decay series. Thorium-232 and radium-224 isotopes from the thorium-232 decay series were also present above reference levels but at a lesser frequency. The subsurface samples generally contained more radionuclides at higher concentrations than the surface samples.

10.3 Potential Migration Pathways

The pathways by which radionuclides have or potentially could migrate from Areas 1 and 2 include:

- Airborne transport of radon gas or transport of radionuclides in fugitive dust;
- Rainwater runoff transport of radionuclides dissolved or suspended in on-site or offsite surface water or rainwater runoff;
- Erosion of Area 1 and 2 soils and transport of radionuclide impacted soils in sediment; and

- Leaching of radionuclides to perched water and discharge at the leachate seep or leaching of radionuclides into the underlying alluvial groundwater and groundwater transport to offsite areas.

10.3.1 Airborne Transport

Review of the radon flux measurements indicated that the radon flux levels over the majority of the surface of Areas 1 and 2 did not exceed EPA standards. Radon flux levels substantially above EPA standards were measured at two locations in Area 1 and two locations in Area 2 indicating that radon flux through the ground surface locally is a potential pathway for radionuclide migration from Areas 1 and 2. Mixing of radon with landfill gases and lateral migration from Area 1 or 2 through the landfill materials does not appear to be a significant migration pathway based upon measurements of radon concentrations in the landfill gas collection system.

Fugitive dust monitoring was conducted at one location in Area 1 and one location in Area 2 in accordance with the EPA approved RI/FS Work Plan. The locations where fugitive dust monitoring was performed contained the highest or some of the highest radionuclide concentrations in surface soil samples. Results of the fugitive dust monitoring indicated that fugitive dust is not a significant pathway for radionuclide migration from Areas 1 and 2.

10.3.2 Rainwater Runoff Transport

Some of the onsite rainwater-runoff samples did contain radionuclides above MCLs. However, none of the radionuclides were measured at levels above MCLs in the samples collected from the nearest offsite surface water bodies. As a result, dissolved or suspended sediment transport in rainwater runoff is a potential pathway for radionuclide migration from Areas 1 and 2 but does not appear to be a significant pathway for offsite migration.

10.3.3 Soil Erosion and Sediment Transport

Some of the sediment samples collected on-site did contain levels of radionuclides above reference levels. One sediment sample collected at the landfill boundary on the southern side of the access road contained radium-226 at a level slightly higher than the reference level. None of the offsite sediment samples contained radionuclides above the reference level.

Previous erosional transport from the northern portion of Area 2 down the landfill berm has resulted in transport of radionuclides onto the southern portion of the Ford property located adjacent to the base of the landfill slope on the northwestern boundary of

Area 2. Soil samples obtained from five of the eleven locations on the Ford property contained radionuclides above the reference level. All of these samples were from the upper 3 to 6 inches of materials. Radionuclides were not detected above reference levels in any of the soil samples obtained from the Ford property at depths of one-foot or more.

Based on the results of the sediment and offsite soil sample analyses, erosion of surface soil from Areas 1 and 2 and subsequent sediment transport has resulted in offsite migration of radionuclides from Areas 1 and 2. Soil erosion and sediment transport is also considered a potential pathway for future migration of radionuclides from Areas 1 and 2 during extreme precipitation events.

10.3.4 Leaching to Groundwater and Groundwater Transport

Perched water is present at isolated locations within the landfill materials in Areas 1 and 2. Very low levels of radionuclides at concentrations of approximately 1 to 2 pCi/l or less were detected in some of the perched water samples.

Perched water discharges from the landfill surface in the western side of Area 2. A sample of this leachate seep indicated that the radioisotopes present in the seep water were all below the Missouri State MCLs. Based upon these results, the leachate seep does not appear to be a significant migration pathway. Seepage discharge is not considered a significant pathway for offsite migration because the water from the seeps does not migrate offsite.

The levels of radionuclides detected in groundwater beneath and adjacent to Areas 1 and 2 generally were below both background levels and the State of Missouri MCLs. Only one well (D-6) contained radionuclides above the Missouri State MCLs and the measured concentrations in this well were just slightly greater than the MCL. Based on the relatively low solubility of radionuclides in water and their affinity to adsorb onto the soil matrix, leaching of radionuclides into groundwater and subsequent transport in groundwater to offsite areas is not considered to be a significant migration pathway.

10.4 Baseline Risk Assessment

The Baseline Risk Assessment (BRA) identified eight radionuclides and their associated daughter products as Chemicals of Potential Concern (CoPCs) based on their relatively long half-lives. Four trace metals were also selected as CoPCs for the human health risk assessment. Based upon a comparison to EPA screening values, other trace metals and various organic compounds detected in the soil samples obtained from Areas 1 and 2 were not selected as CoPCs as the maximum detected values of these constituents did not exceed the risk-based screening levels.

Several potential human receptors were identified in the BRA including a groundskeeper currently working adjacent to Areas 1 and 2, a groundskeeper that may work on Areas 1 and 2 in the future, a current or future groundskeeper working offsite on the Ford property. Possible future scenarios associated with potential worker exposures associated with possible future uses of Areas 1 and 2 for parking or outdoor storage in conjunction with possible future commercial/industrial development of other portions of the landfill were also evaluated. The potential pathways by which these receptors could potentially be exposed to contaminants present in Areas 1 and 2 included exposure to external radiation, inhalation of radon gas or dust containing radionuclides or other constituents, dermal contact with impacted materials, or incidental ingestion of soil containing radionuclides or other chemicals. Potential for exposure to contaminated groundwater was not expected to be a significant pathway given the distance to the nearest drinking water well and the fact that all businesses and residences in the area use municipal drinking water supplies.

Based upon an assessment of the carcinogenic potential and systemic toxic effects associated with each of the CoPCs, combined with the exposure assessment scenarios, potential risks were calculated for each potential receptor. These calculations indicated that the potential exposure to external radiation for the hypothetical groundskeeper that currently could work adjacent to Areas 1 and 2 resulted in a carcinogenic risk of 1×10^{-5} for Area 1 and 4×10^{-5} (one additional cancer incidence per 100,000 people) for Area 2. These calculated risks were within the generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}. No adverse systemic effects to the groundskeeper were identified. The potential risks to a hypothetical groundskeeper working on the Ford property adjacent to Area 2 resulted in a carcinogenic risk of 6×10^{-7} which is also within generally acceptable risk range used by EPA of 10^{-4} to 10^{-6}. As the surface soil that previously existed on the buffer zone and Crossroad Lot 2A2 was removed and subsequent sampling results displayed lower levels of radionuclides, the actual current risk on the former Ford property would be even lower.

The potential risks to the future onsite groundskeeper working in Areas 1 and 2 were calculated at 6×10^{-5} for Area 1 and 2×10^{-4} for Area 2. As with the current exposure scenario, the calculated risk for a possible future exposure for a hypothetical offsite (Ford property) groundskeeper receptor (2×10^{-6}) was within EPA's generally accepted risk range.

The potential risks to the future worker in a building adjacent to Areas 1 and 2 that may use these areas for parking was calculated to be 1×10^{-5} for Area 1 and 4×10^{-5} for Area 2, both of which are within the generally accepted risk range of 10^{-4} to 10^{-6} used by EPA. The potential risks to the future worker that may be involved in outdoor storage uses conducted on Areas 1 and 2 was calculated to be 1×10^{-4} for Area 1 and 4×10^{-4} for Area 2.

Non-radiological CoPCs are not projected to cause unacceptable risks under either the current or future exposure scenarios. Uncertainties associated with the human health risk assessment were addressed through the use of conservative assumptions likely resulting in an overestimate of the actual risks that may occur.

The ecological assessment indicated that contaminants present in OU-1 might have an adverse impact upon the environment. Plants, soil invertebrates, small wildlife species and mammalian predators may be adversely impacted as a result of exposure to contaminants, including trace metals, present in OU-1 soils. It should be noted however, that some of the ecosystems present at the landfill are the result of existing institutional controls and other limitations on land use within or adjacent to OU-1 that have allowed field succession to take place. Therefore, any disturbance of the landfill such as might occur with remediation activities may significantly alter or destroy the habitats that currently exist forcing wildlife to migrate to other areas. In addition, increasing development of areas around the landfill has, and will continue to remove significant amounts of wildlife habitat forcing some larger species to leave this area and reducing the overall ability of the area to support some types of wildlife.

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Tables

Table 4-1: Summary of Site Investigation Activities and Investigative Data Reports

Site Investigation Activity	Investigation Data Report Title
Site reconnaissance	Site Reconnaissance Report (McLaren/Hart, 1996b)
Threatened or endangered species assessment	Threatened or Endangered Species Assessment Report (McLaren/Hart, 1996c)
Overland gamma survey	Overland Gamma Survey Report (McLaren/Hart, 1996a)
Surface and subsurface soil and perched water investigations	Soil Borings/Surface Soil Investigation Report (McLaren/Hart, 1996h), Split Soil and Groundwater Sampling Data Summary Report (McLaren/Hart, 1996f), and Site Characterization Summary Report (EMSI,1997c)
Groundwater investigations	Groundwater Conditions Report (McLaren/Hart, 1996g), Split Soil and Groundwater Sampling Data Summary Report (McLaren/Hart, 1996g) and Site Characterization Summary Report (EMSI,1997c)
Rainwater runoff, surface water and sediment sampling and analyses	Rainwater Runoff, Erosional Sediment, Surface Water, and Leachate Sampling Data Report (McLaren/Hart, 1996e) and Site Characterization Summary Report (EMSI, 1997c)
Ambient air (fugitive dust and soil gas) measurements	Radon Gas, Landfill Gas and Fugitive Dust Report (McLaren/Hart, 1996d)
Evaluation of radiological emissions	Radon Gas, Landfill Gas and Fugitive Dust Report (McLaren/Hart, 1996d) and Site Characterization Summary Report (EMSI, 1997c)

Table 4-2 : Summary of Geotechnical Testing Results

Sample Number	Water Content (%)	Wet Density (pcf)	Dry Density (pcf)	Comments
1	20.3	111.5	92.7	
2	14.2	--	--	Sample disturbed
3	29.1	90.7	70.3	Direct shear test also
4	27.2	95.0	74.7	

-- indicates sample not tested

Table 4-3 : Summary of RI Depth to Water Measurements

Well	Northing	Easting	Reference Point Elevation (Feet, MSL)	Depth to Water (Feet below TOC)																
				1994		1995											1996			
				Nov. 22, 23, 28	December 29	January 30	March 3	March 30	April 28	May 26	June 30	July 28, Aug. 3*	Aug 31	Oct. 2	Oct. 31	Nov. 30	Jan. 5	April 2	July 5	Oct. 2
Shallow Wells																				
S-1	1069685.83	514205.01	446.51	----	----	----	----	----	----	----	----	----	12.26	13.75	14.38	14.88	15.62	16.94	12.01	13.99
S-5	1069155.84	515901.03	468.65	----	----	----	----	----	----	----	----	----	34.2	35.78	36.51	36.84	37.62	38.96	34.02	35.92
S-8	1071044.35	514724.16	444.03	----	----	----	----	----	----	----	----	----	----	----	11.85	12.52	13.19	14.50	9.11	11.51
S-10	1069827.87	514931.35	480.28	----	----	----	----	----	----	----	----	----	----	47.37	48.16	48.61	49.17	50.85	45.71	47.77
S-51	1066161.31	514320.72	449.57	18.77	18.66	17.81	18.22	18.2	17.81	13.38	14.41	14.81	15.54	16.74	17.42	17.46	17.98	19.09	15.43	16.95
S-53	1066871.02	514496.97	447.95	17.27	17.37	16.47	16.93	16.86	16.30	12.57	12.99	13.06	13.77	15.17	15.89	17.97	16.65	18.04	casing damaged	casing damaged
S-61	1070159.98	514580.24	449.78	19.55	19.61	18.73	19.00	18.97	18.51	13.36	13.86	----	15.27	16.76	17.51	18.18	18.93	20.29	15.08	17.25
S-75	1067250.41	514718.75	462.08	29.92	30.05	29.12	29.85	29.42	29.22	25.31	26.61	26.88	27.41	28.91	29.56	29.81	29.90	29.89	27.23	29.20
S-80	1065191.77	513858.35	453.11	19.15	18.97	17.48	16.96	16.17	16.28	12.70	13.91	14.69	14.85	15.82	16.55	17.77	18.87	18.99	abandoned	abandoned
S-82	1069311.99	514272.95	450.18	19.82	19.88	19.05	19.35	19.32	18.71	14.19	14.80	15.02	15.91	17.40	18.11	18.43	19.15	20.61	15.69	17.59
S-84	1069633.39	516439.68	456.23	26.59	26.60	25.67	25.92	25.89	25.68	20.37	20.88	21.49	22.26	23.92	24.67	25.21	25.87	27.07	22.15	24.42
S-88	1068398.39	515234.03	462.76	32.18	32.44	31.51	29.41	31.9	31.43	27.23	27.62	27.73	28.60	30.01	30.72	29.95	31.71	33.11	28.43	30.26
MW-F1S	1068603.00	515865.35	461.35	31.11	31.00	30.26	30.42	30.42	30.05	25.74	26.05	26.32	27.06	28.52	29.26	29.58	30.31	31.69	26.99	28.86
MW-101	1070830.48	514424.00	446.83	16.68	16.73	15.91	16.13	16.11	15.67	10.51	----	----	12.20	13.91	14.67	15.29	16.04	17.37	12.02	14.34
MW-102	1070095.01	514532.93	448.18	17.95	18.00	17.18	17.41	17.38	16.91	11.64	12.31	12.81	13.70	15.32	16.06	18.58	17.16	18.67	13.47	15.64
MW-103	1068628.37	514334.35	440.31	9.72	9.91	9.01	9.43	9.37	8.79	5.15	5.39	5.34	6.22	7.57	8.25	8.49	9.26	10.61	6.51	7.59
MW-104	1067525.17	514339.01	440.96	10.33	10.43	9.48	9.98	9.93	9.33	5.72	6.11	6.13	6.95	8.27	8.95	9.06	9.71	11.11	6.78	8.39
MW-106	1065955.75	513616.92	443.78	12.85	12.90	12.28	12.45	12.44	12.07	8.39	8.36	8.56*	9.27	casing damaged	NM	NM	NM	NM	NM	NM
MW-107	1064670.74	513601.12	448.14	5.13	5.44	4.53	5.36	5.1	5.26	----	4.71	5.57	6.06	8.39	9.07	6.36	5.99	5.68	6.17	6.46
MW-F3	1070489.80	515819.83	469.23	38.96	38.97	38.09	38.00	38.29	38.06	32.31	32.94	36.62	34.47	36.21	37.02	37.61	38.39	39.60	34.33	36.73
Intermediate Depth Wells																				
I-2	1069698.26	514212.18	446.41	----	----	----	----	----	----	----	----	----	12.03	13.68	14.31	14.76	15.47	16.90	11.92	13.90
I-4	1069148.42	515889.5	468.57	----	----	----	----	----	----	----	----	----	34.19	35.75	36.45	38.85	37.62	38.92	33.96	35.95
I-7	1070743.05	514299.87	446.97	----	----	----	----	----	----	----	----	----	12.41	14.10	14.87	15.43	16.15	17.52	12.18	14.47
I-9	1069329.26	514268.59	450.99	----	----	----	----	----	----	----	----	----	----	----	18.79	19.2	19.98	21.40	16.52	18.40
I-11	1069819.16	514925.06	480.27	----	----	----	----	----	----	----	----	----	----	----	48.14	48.61	49.35	50.75	45.69	47.74
I-50	1065190.32	513831.96	453.66	22.02	22.27	21.26	21.76	21.65	21.13	16.60	17.40	19.96	18.74	20.27	21	21.03	21.57	23.05	abandoned	abandoned
I-62	1070938.26	514647.31	446.21	15.99	16.07	15.19	15.47	15.42	15.03	9.87	9.90	10.34*	11.55	13.02	13.78	14.71	15.36	16.71	11.34	13.71
I-65	1070953.26	515333.39	441.82	11.6	11.70	10.83	11.00	11.03	10.66	5.25	7.35	8.12	7.04	8.81	9.66	10.3	11.06	12.31	6.87	9.36
I-66	1070604.09	515851.01	441.91	11.61	11.66	10.78	11.00	10.95	10.61	5.18	5.56	6.26	7.11	8.83	9.69	10.32	11.04	12.28	6.98	9.45
I-67	1070101.57	516244.09	441.90	11.54	11.57	10.63	10.93	10.97	10.65	5.06	5.65	6.31	7.11	8.81	9.61	10.23	10.87	12.16	7.03	9.39
I-68	1069571.49	516686.36	450.50	20.16	20.10	19.05	19.44	19.45	19.24	13.94	14.52	16.16	15.91	17.52	18.29	18.8	19.45	20.64	15.74	18.03
I-73	1067695.45	515570.09	461.39	31.46	31.68	30.80	31.12	31.9	30.69	26.04	27.15	27.25	27.97	29.39	30.12	30.31	31.00	32.35	28.87	29.52
Deep Wells																				
D-3	1069136.26	515871.62	470.32	----	----	----	----	----	----	----	----	----	35.92	37.49	38.21	38.63	39.43	40.70	35.74	37.78
D-6	1070194.31	514549.5	447.6	----	----	----	----	----	----	----	----	----	13.23	14.82	15.5	16.09	16.77	18.16	12.99	15.12
D-12	1069836.29	514936.08	479.91	----	----	----	----	----	----	----	----	----	----	----	48	48.32	48.98	50.42	45.33	47.42
D-13	1070485.74	515601.73	471.1	----	----	----	----	----	----	----	----	----	----	----	38.94	39.48	40.19	41.49	36.21	38.53
D-14	1068947.16	516523.17	487.77	----	----	----	----	----	----	----	----	----	----	----	0	NM	58.62	59.69	56.21	57.79
D-81	1067338.19	514463.68	451.00	20.3	20.39	19.56	19.95	19.95	19.29	15.62	16.08	16.14	16.91	18.24	18.95	19.04	19.71	21.11	16.78	18.37
D-83	1070930.4	514633.64	448.48	18.29	18.40	17.50	17.82	17.76	17.27	12.17	12.16	12.61*	13.88	15.70	16.41	17.01	17.77	19.01	13.72	16.02
D-85	1069626.55	516430.42	457.13	26.82	26.77	25.87	26.12	26.13	25.89	20.60	21.11	21.71	22.48	24.13	24.87	25.42	26.11	27.39	22.39	24.61
D-87	1069211.46	515404.82	463.05	32.81	32.82	31.96	32.19	32.2	31.81	27.10	27.57	27.86	28.69	30.28	30.96	31.36	32.11	33.54	28.60	30.58
D-93	1069317.89	514269.69	448.62	19.66	19.74	18.92	19.22	19.18	18.58	14.02	14.67	14.83	15.79	17.25	18.01	18.34	19.06	20.51	15.59	17.50
MW-F1D	1068608.68	515860.04	461.63	31.42	31.31	30.51	30.70	30.78	30.41	26.04	26.34	26.61	27.36	28.86	29.6	29.88	30.62	32.02	27.29	29.19
Staff Gages																				
1	1071100.73	514883.10	438.57	----	----	----	----	----	----	----	4.2	3.25	2.35	----	1.5	Dry	Dry	Dry	2.30	Dry
2	1071107.71	514878.03	438.84	----	----	----	----	----	----	----	3.95	3.05	2.1	----	1.25	Dry	Dry	Dry	2.25	Dry
3	1071249.28	514645.19	440.73	----	----	----	----	----	----	----	1.98	1.05	< 0.5	----	3.2	Dry	Dry	Dry	Dry	Dry
4	1071253.42	514635.63	441.05	----	----	----	----	----	----	----	1.7	0.80	< 0.5	----	2.95	Dry	Dry	Dry	Dry	Dry
5	1070745.51	515414.94	460.94	----	----	----	----	----	----	----	----	----	----	----	Dry	Dry	Dry	Dry	Dry	Dry
6	1069471.76	514096.61	437.28	----	----	----	----	----	----	----	2.18	2.64	1.55	----	0.25	0.7	Dry	Dry	1.75	0.80
7	1069480.90	514091.25	437.01	----	----	----	----	----	----	----	2.45	2.95	1.8	0.30	0	1	Dry	Dry	2.00	1.00

NM = Not Measured

Table 4-4 : Summary of RI Groundwater Elevation Measurements

Well	Northing	Easting	Reference Point Elevation (Feet, MSL)	Groundwater Elevation (Feet, MSL)																
				1994		1995											1996			
				Nov. 22, 23, 28	December 29	January 30	March 3	March 30	April 28	May 26	June 30	July 28, Aug. 3*	Aug 31	Oct. 2	Oct. 31	Nov. 30	Jan. 5	April 2	July 5	Oct. 2
Shallow Depth Wells																				
S-1	1069685.83	514205.01	446.51	—	—	—	—	—	—	—	—	—	434.25	432.76	432.13	431.63	430.89	429.57	434.50	432.52
S-5	1069155.84	515901.03	468.65	—	—	—	—	—	—	—	—	—	434.45	432.87	432.14	431.81	431.03	429.69	434.63	432.73
S-8	1071044.35	514724.16	444.03	—	—	—	—	—	—	—	—	—	—	—	432.18	431.51	430.84	429.53	434.92	432.52
S-10	1069827.87	514931.35	480.28	—	—	—	—	—	—	—	—	—	—	432.91	432.12	431.67	431.11	429.43	434.57	432.51
S-51	1066161.31	514320.72	449.57	430.8	430.91	431.76	431.35	431.37	431.76	436.19	435.16	434.76	434.03	432.83	432.15	432.11	431.59	430.48	434.14	432.62
S-53	1066871.02	514496.97	447.95	430.68	430.58	431.48	431.02	431.09	431.65	435.38	434.96	434.89	434.18	432.78	432.06	429.98	431.30	429.91	casing damaged	casing damaged
S-61	1070159.98	514580.24	449.78	430.23	430.17	431.05	430.78	430.81	431.27	436.42	435.92	—	434.51	433.02	432.27	431.6	430.85	429.49	434.70	432.53
S-75	1067250.41	514718.75	462.08	432.16	432.03	432.96	432.23	432.66	432.86	436.77	435.47	435.20	434.67	433.17	432.52	432.27	432.18	432.19	434.85	432.88
S-80	1065191.77	513858.35	453.11	433.96	434.14	435.63	436.15	436.94	436.83	440.41	439.20	438.42	438.26	437.29	436.56	435.34	434.24	434.12	abandoned	abandoned
S-82	1069311.99	514272.95	450.18	430.36	430.30	431.13	430.83	430.86	431.47	435.99	435.38	435.16	434.27	432.78	432.07	431.75	431.03	429.57	434.49	432.59
S-84	1069633.39	516439.68	456.23	429.64	429.63	430.56	430.31	430.34	430.55	435.86	435.35	434.74	433.97	432.31	431.56	431.02	430.36	429.16	434.08	431.81
S-88	1068398.39	515234.03	462.76	430.58	430.32	431.25	433.35	430.86	431.33	435.53	435.14	435.03	434.16	432.75	432.04	432.81	431.05	429.65	434.33	432.50
MW-F1S	1068603.00	515865.35	461.35	430.24	430.35	431.09	430.93	430.93	431.30	435.61	435.30	435.03	434.29	432.83	432.09	431.77	431.04	429.66	434.36	432.49
MW-101	1070830.48	514424.00	446.83	430.15	430.10	430.92	430.70	430.72	431.16	436.32	—	—	434.63	432.92	432.16	431.54	430.79	429.46	434.81	432.49
MW-102	1070095.01	514532.93	448.18	430.23	430.18	431.00	430.77	430.8	431.27	436.54	435.87	435.37	434.48	432.86	432.12	429.6	431.02	429.51	434.71	432.54
MW-103	1068628.37	514334.35	440.31	430.59	430.40	431.30	430.88	430.94	431.52	435.16	434.92	434.97	434.09	432.74	432.06	431.82	431.05	429.7	433.80	432.72
MW-104	1067525.17	514339.01	440.96	430.63	430.53	431.48	430.98	431.03	431.63	435.24	434.85	434.83	434.01	432.69	432.01	431.9	431.25	429.85	434.18	432.57
MW-106	1065955.75	513616.92	443.78	430.93	430.88	431.50	431.33	431.34	431.71	435.39	435.42	435.22	434.51	—	NM	NM	NM	NM	NM	NM
MW-107	1064670.74	513601.12	448.14	443.01	442.70	443.61	442.78	443.04	442.88	—	443.43	442.57	442.08	439.75	439.07	441.78	442.15	442.46	441.97	441.68
MW-F3	1070489.80	515819.83	469.23	430.27	430.26	431.14	431.23	430.94	431.17	436.92	436.29	432.61	434.76	433.02	432.21	431.62	430.84	429.63	434.90	432.50
Intermediate Depth Wells																				
I-2	1069698.26	514212.18	446.41	—	—	—	—	—	—	—	—	—	434.38	432.73	432.1	431.65	430.94	429.51	434.49	432.51
I-4	1069148.42	515889.5	468.57	—	—	—	—	—	—	—	—	—	434.38	432.82	432.12	429.72	430.95	429.65	434.61	432.62
I-7	1070743.05	514299.87	446.97	—	—	—	—	—	—	—	—	—	434.56	432.87	432.1	431.54	430.82	429.45	434.79	432.50
I-9	1069329.26	514268.59	450.99	—	—	—	—	—	—	—	—	—	—	—	432.2	431.79	431.01	429.59	434.47	432.59
I-11	1069819.16	514925.06	480.27	—	—	—	—	—	—	—	—	—	—	—	432.13	431.66	430.92	429.52	434.58	432.53
I-50	1065190.32	513831.96	453.66	431.64	431.39	432.40	431.90	432.01	432.53	437.06	436.26	433.70	434.92	433.39	432.66	432.63	432.09	430.61	abandoned	abandoned
I-62	1070938.26	514647.31	446.21	430.22	430.14	431.02	430.74	430.79	431.18	436.34	436.31	435.87	434.66	433.19	432.43	431.5	430.85	429.5	434.87	432.50
I-65	1070953.26	515333.39	441.82	430.22	430.12	430.99	430.82	430.79	431.16	436.57	434.47	433.70	434.78	433.01	432.16	431.52	430.76	429.51	434.95	432.46
I-66	1070604.09	515851.01	441.91	430.3	430.25	431.13	430.91	430.96	431.30	436.73	436.35	435.65	434.80	433.08	432.22	431.59	430.87	429.63	434.93	432.46
I-67	1070101.57	516244.09	441.90	430.36	430.33	431.27	430.97	430.93	431.25	436.84	436.25	435.59	434.79	433.09	432.29	431.67	431.03	429.74	434.87	432.51
I-68	1069571.49	516686.36	450.50	430.34	430.40	431.45	431.06	431.05	431.26	436.56	435.98	434.34	434.59	432.98	432.21	431.7	431.05	429.86	434.76	432.47
I-73	1067695.45	515570.09	461.39	429.93	429.71	430.59	430.27	429.49	430.70	435.35	434.24	434.14	433.42	432.00	431.27	431.08	430.39	429.04	432.52	431.87
Deep Depth Wells																				
D-3	1069136.26	515871.62	470.32	—	—	—	—	—	—	—	—	—	434.40	432.83	432.11	431.69	430.89	429.62	434.58	432.54
D-6	1070194.31	514549.5	447.6	—	—	—	—	—	—	—	—	—	434.37	432.78	432.1	431.51	430.83	429.44	434.61	432.48
D-12	1069836.29	514936.08	479.91	—	—	—	—	—	—	—	—	—	—	—	431.91	431.59	430.93	429.49	434.58	432.49
D-13	1070485.74	515601.73	471.1	—	—	—	—	—	—	—	—	—	—	—	432.16	431.62	430.91	429.61	434.89	432.57
D-14	1068947.16	516523.17	487.77	—	—	—	—	—	—	—	—	—	—	—	Dry	NM	429.15	428.08	431.56	429.98
D-81	1067338.19	514463.68	451.00	430.7	430.61	431.44	431.05	431.05	431.71	435.38	434.92	434.86	434.09	432.76	432.05	431.96	431.29	429.89	434.22	432.63
D-83	1070930.4	514633.64	448.48	430.19	430.08	430.98	430.66	430.72	431.21	436.31	436.32	435.87	434.60	432.78	432.07	431.47	430.71	429.47	434.76	432.46
D-85	1069626.55	516430.42	457.13	430.31	430.36	431.26	431.01	431	431.24	436.53	436.02	435.42	434.65	433.00	432.26	431.71	431.02	429.74	434.74	432.52
D-87	1069211.46	515404.82	463.05	430.24	430.23	431.09	430.86	430.85	431.24	435.95	435.48	435.19	434.36	432.77	432.09	431.69	430.94	429.51	434.45	432.47
D-93	1069317.89	514269.69	448.62	428.96	428.88	429.70	429.40	429.44	430.04	434.60	433.95	433.79	432.83	431.37	430.61	430.28	429.56	428.11	433.03	431.12
MW-F1D	1068608.68	515860.04	461.63	430.21	430.32	431.12	430.93	430.85	431.22	435.59	435.29	435.02	434.27	432.77	432.03	431.75	431.01	429.61	434.34	432.44
Staff Gages																				
1	1071100.73	514883.10	438.57	—	—	—	—	—	—	—	437.27	436.32	435.42	—	434.57	—	—	—	435.37	—
2	1071107.71	514878.03	438.84	—	—	—	—	—	—	—	437.29	436.39	435.44	—	434.59	—	—	—	435.59	—
3	1071249.28	514645.19	440.73	—	—	—	—	—	—	—	437.21	436.28	—	—	438.43	—	—	—	—	—
4	1071253.42	514635.63	441.05	—	—	—	—	—	—	—	437.25	436.35	—	—	438.5	—	—	—	—	—
5	1070745.51	515414.94	460.94	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
6	1069471.76	514096.61	437.28	—	—	—	—	—	—	—	433.96	434.42	433.33	—	432.03	432.48	—	—	433.53	432.58
7	1069480.90	514091.25	437.01	—	—	—	—	—	—	—	433.96	434.46	433.31	431.81	—	432.51	—	—	433.51	432.51

---- and NM = Not Measured

Table 4-5 : Summary of Groundwater Monitoring Wells Sampled as Part of the RI

Well No.	Interval Monitored	Source of Well
S-1	Shallow	New RI well
S-5	Shallow	New RI well
S-8	Shallow	New RI well
S-10	Shallow	New RI well
S-61	Shallow	Existing well
S-80	Shallow	Existing background well
S-82	Shallow	Existing well
S-84	Shallow	Existing well
MW-101	Shallow	Existing well
MW-107	Shallow	Existing background well
MW-F3	Shallow	New landfill well
PZ-114-AS	Shallow	New landfill well
I-2	Intermediate	New RI well
I-4	Intermediate	New RI well
I-7	Intermediate	New RI well
I-9	Intermediate	New RI well
I-11	Intermediate	New RI well
I-62	Intermediate	Existing well
I-65	Intermediate	Existing well
I-66	Intermediate	Existing well
I-67	Intermediate	Existing well
I-68	Intermediate	Existing well
D-3	Deep	New RI well
D-6	Deep	New RI well
D-12	Deep	New RI well
D-13	Deep	New RI well
D-14	Deep	New RI well
D-83	Deep	Existing well
D-85	Deep	Existing well
D-93	Deep	Existing well

Table 4-6
Monitoring Well Construction Summary
West Lake Landfill, Bridgeton, Missouri

Well	Northing	Easting	Elevation: Reference Point Top of Casing (Feet, MSL)	Elevation: Ground Surface (Feet, MSL)	Screened Interval: Length of Screen (Feet)	Screened Interval: Depth (Feet Below TOC) Top	Depth (Feet Below TOC) Bottom	Screened Interval: Elevation (Feet, MSL) Top	Elevation (Feet, MSL) Bottom
Shallow Wells									
S-1	1069685.83	514205.01	446.51	443.3	20	5.21	25.21	441.3	421.3
S-5	1069155.84	515901.03	468.65	465.7	10	32.95	42.95	435.7	425.7
S-8	1071044.35	514724.16	444.03	441.6	20	9.43	29.43	434.6	414.6
S-10	1069827.87	514931.35	480.28	477.5	20	34.78	54.78	445.5	425.5
S-61	1070160	514580	450.17	445.6			21.5		424.1
S-80	1065190	513870	452.55	448.4	10	10	20	418.4	428.4
S-82	1069312	514273	447.7	450.7	10	15.5	25.5	412.2	422.2
S-84	1069685	516455	452.9	455.3	10	20.9	30.9	412.0	422.0
MW-101	NI	NI	447.66	445.36	10	15	25	420.36	430.36
MW-107	NI	NI	449.25	NI	10	5	15	NI	NI
MW-F3	1070380	515880	NI	NI	10	32.8	42.8	NI	NI
PZ-114-AS	1069418.88	516768.25	451.31	449.8	9.8	19.9	29.7	420.08	429.88
Intermediate Depth Wells									
I-2	1069698.26	514212.18	446.41	443.2	10	40.21	50.21	406.2	396.2
I-4	1069148.42	515889.5	468.57	466	10	68.57	78.57	400	390
I-7	1070743.05	514299.87	446.97	444.5	10	39.47	49.47	407.5	397.5
I-9	1069329.26	514268.59	450.99	448.5	10	45.49	55.49	405.5	395.5
I-11	1069819.16	514925.06	480.27	477.6	10	83.67	93.67	396.6	386.6
I-62	1070960	514675	446.08	444.1	10	34	44	420.1	410.1
I-65	1070940	515435	441.8	438.5	10	26	36	422.5	412.5
I-66	1070520	515935	441.8	437.7	10	26.9	36.9	420.8	410.8
I-67	1070090	516260	439.08	436.5	10	25.4	35.4	421.1	411.1
I-68	1069570	516690	448.32	440.9	10	21.2	31.2	429.7	419.7
Deep Wells									
D-3	1069136.26	515871.62	470.32	467.2	10	99.12	109.12	371.2	361.2
D-6	1070194.31	514549.5	447.6	444.4	10	99.2	109.2	348.4	338.4
D-12	1069836.29	514936.08	479.91	477.4	10	136.51	146.51	343.4	333.4
D-13	1070485.74	515601.73	471.1	468.4	10	125.7	135.7	345.4	335.4
D-14	1068947.16	516523.17	487.77	484.5	5	57.27	62.27	430.5	425.5
D-83	1070940	514660	447.70	444.40	20	77	97	367.4	347.4
D-85	1069680	516445	455.65	453.10	20	62	82	391.1	371.1
D-93	1069318	514270	450.70	448.30	20	92	112	356.3	356.3

TABLE 4 - 7
SOIL VAPOR METHANE CONCENTRATIONS (%)
RADIOLOGICAL AREAS 1 AND 2
WEST LAKE LANDFILL, BRIDGETON, MISSOURI

Boring	Depth (feet)	% Methane
AREA 1		
WL-101	5	39
	10	38
WL-102	5	18
	10	43
WL-103	5	18
	10	8.7
WL-104	5	5.9
	10	--
WL-105	5	39
	10	--
WL-106	5	9.1
	10	14
WL-107	5	36
	10	--
WL-108	5	45
	10	34
WL-109	5	2.7
	10	0.38
WL-110	5	37
	10	41
WL-111	5	45
	10	45
WL-112	5	BRL
	10	--
WL-113	5	0.52
	10	40
WL-114	5	39
	10	6.8
WL-115	5	12
	10	--
WL-116	5	33
	10	--
WL-117	5	40
	10	27
WL-120	5	33
	10	--
AREA 2		
WL-201	5	--
	10	--
WL-202	5	BRL
	10	BRL
WL-203	5	BRL
	10	BRL
WL-204/205	5	BRL
	10	BRL
WL-206	5	BRL
	10	BRL
WL-207	5	--
	10	--
WL-208	5	18
	10	23

Boring	Depth (feet)	% Methane
AREA 2 (cont.)		
WL-209	5	23
	10	0.48
WL-210	5	25
	10	19
WL-211	5	6.3
	10	0.39
WL-212	5	BRL
	10	--
WL-213	5	21
	10	13
WL-214	5	BRL
	10	BRL
WL-215	5	BRL
	10	--
WL-216	5	23
	10	0.23
WL-217	5	6.6
	10	24
WL-218	5	17
	10	24
WL-219	5	17
	10	22
WL-220	5	24
	10	24
WL-221	5	BRL
	10	4.9
WL-222	5	2.5
	10	--
WL-223	5	0.20
	10	0.21
WL-224	5	19
	10	--
WL-225	5	BRL
	10	BRL
WL-226	5	0.23
	10	--
WL-227	5	20
	10	13
WL-230	5	28
	10	0.21
WL-231	5	0.21
	10	15
WL-233	5	13
	10	23
WL-234	5	19
	10	23
WL-235	5	30
	10	29
WL-236	5	0.39
	10	BRL
WL-239	5	0.49
	10	0.35

' = feet
-- = Sample not collected due to encountering landfill obstructions
BRL = Below Reporting Limit
bls = Below Land Surface

Table 5-1: Summary of Plant Species Present in or Near Areas 1 and 2

Scientific Name	Common Name	Area 1	Area 2	North Flood Control Channel	West Flood Control Channel	Ford Property
			Trees/Shrubs			
Acer negundo	Box elder		X			X
Cercis canadensis	Red bud		X			
Cornus amomum	Silky dogwood		X	X		
Fraxinus spp.	Ash		X	X		
Morus spp.	Mulberry		X			
Populus deltoides	Eastern Cottonwood		X	X		X
Rhus typhina	Staghorn Sumac		X	X		X
Salix amygdaloides	Peached-leaved willow		X			
Salix spp.	Willow		X	X		
			Woody Vines			
Toxicodendron radicans	Poison ivy		X	X		X
Vitis spp.	Grape		X	X		X
			Herbs and Grasses			
Andropogon spp.	Bluestem	X				
Ambrosia spp.	Ragweed					X
Ascelpias syriaca	Common milkweed		X			
Carduus crispus	Nodding thistle	X	X			X
Daucus carota	Wild carrot		X			
Erigeron annuus	Daisy fleabane		X			X
Gallium spp.	Bedstraw		X	X		
Graminae	Unknown grasses	X	X	X	X	X
Impatiens capensis	Jewelweed		X			
Juncus spp.	Rush	X				
Melilotus alba	White sweet clover		X			
Opuntia compressa	Prickly pear		X			
Phytolacca americana	Pokeweed		X	X		
Plantago major	Common plantian	X				X
Polygonum spp.	Smartweed					X
Rumax crispus	Curled-dock	X	X			X
Solidago spp.	Goldenrod	X	X			X
Setaria spp.	Foxtail	X	X			X
Thlaspi arvense	Field pennycress	X	X			X
Trifolium pratense	Red clover		X			
Trifolium procumbens	Yellow sweet clover		X			X
Typha spp.	Cattails	X	X			
Vicia cracca	Cow vetch		X			X

Table 5-2 : Summary of Water Level Measurements from Well Clusters

Well Cluster	Groundwater Elevation (Feet, MSL)																
	1994		1995											1996			
	Nov. 22, 23, 28	December 29	January 30	March 3	March 30	April 28	May 26	June 30	July 28, Aug 3*	Aug 31	Oct. 2	Oct. 31	Nov 30	Jan. 5	April 2	July 5	Oct 2
S-1	----	----	----	----	----	----	----	----	----	434.25	432.76	432.13	431.63	430.89	429.57	434.50	432.52
I-2	----	----	----	----	----	----	----	----	----	434.38	432.73	432.1	431.65	430.94	429.51	434.49	432.51
S-5	----	----	----	----	----	----	----	----	----	434.45	432.87	432.14	431.81	431.03	429.69	434.63	432.73
I-4	----	----	----	----	----	----	----	----	----	434.38	432.82	432.12	429.72	430.95	429.65	434.61	432.62
D-3	----	----	----	----	----	----	----	----	----	434.40	432.83	432.11	431.69	430.89	429.62	434.58	432.54
S-8	----	----	----	----	----	----	----	----	----	----	----	432.18	431.51	430.84	429.53	434.92	432.52
I-62	430.22	430.14	431.02	430.74	430.79	431.18	436.34	436.31	435.87	434.66	433.19	432.43	431.5	430.85	429.5	434.87	432.50
D-83	430.19	430.08	430.98	430.66	430.72	431.21	436.31	436.32	435.87	434.60	432.78	432.07	431.47	430.71	429.47	434.76	432.46
S-10	----	----	----	----	----	----	----	----	----	----	432.91	432.12	431.67	431.11	429.43	434.57	432.51
I-11	----	----	----	----	----	----	----	----	----	----	----	432.13	431.66	430.92	429.52	434.58	432.53
D-12	----	----	----	----	----	----	----	----	----	----	----	431.91	431.59	430.93	429.40	434.58	432.49
S-61	430.23	430.17	431.05	430.78	430.81	431.27	436.42	435.92	----	434.51	433.02	432.27	431.6	430.85	429.49	434.70	432.53
MW-102	430.23	430.18	431.00	430.77	430.8	431.27	436.54	435.87	435.37	434.48	432.86	432.12	429.6	431.02	429.51	434.71	432.54
D-6	----	----	----	----	----	----	----	----	----	434.37	432.78	432.1	431.51	430.83	429.44	434.61	432.48
S-80	433.96	434.14	435.63	436.15	436.94	436.83	440.41	439.20	438.42	438.26	437.29	436.56	435.34	434.24	434.12	abandoned	abandoned
I-50	431.64	431.39	432.40	431.90	432.01	432.53	437.06	436.26	433.70	434.92	433.39	432.66	432.63	432.09	430.61	abandoned	abandoned
S-82	430.36	430.30	431.13	430.83	430.86	431.47	435.99	435.38	435.16	434.27	432.78	432.07	431.75	431.03	429.57	434.49	432.59
I-9	----	----	----	----	----	----	----	----	----	----	----	432.2	431.79	431.01	429.59	434.47	432.59
D-93	428.96	428.88	429.70	429.40	429.44	430.04	434.60	433.95	433.79	432.83	431.37	430.61	430.28	429.56	428.11	433.03	431.12
S-84	429.64	429.63	430.56	430.31	430.34	430.55	435.86	435.35	434.74	433.97	432.31	431.56	431.02	430.36	429.16	434.08	431.81
I-67	430.36	430.33	431.27	430.97	430.93	431.25	436.84	436.25	435.59	434.79	433.09	432.29	431.67	431.03	429.74	434.87	432.51
I-68	430.34	430.40	431.45	431.06	431.05	431.26	436.56	435.98	434.34	434.59	432.98	432.21	431.7	431.05	429.86	434.76	432.47
D-85	430.31	430.36	431.26	431.01	431	431.24	436.53	436.02	435.42	434.65	433.00	432.26	431.71	431.02	429.74	434.74	432.52
MW-F3	430.27	430.26	431.14	431.23	430.94	431.17	436.92	436.29	432.61	434.76	433.02	432.21	431.62	430.84	429.63	434.90	432.50
I-66	430.3	430.25	431.13	430.91	430.96	431.30	436.73	436.35	435.65	434.80	433.08	432.22	431.59	430.87	429.63	434.93	432.46
D-13		----	----	----	----	----	----	----	----	----	----	432.16	431.62	430.91	429.61	434.89	432.57
MW-F1S	430.24	430.35	431.09	430.93	430.93	431.30	435.61	435.30	435.03	434.29	432.83	432.09	431.77	431.04	429.66	434.36	432.49
MW-F1D	430.21	430.32	431.12	430.93	430.85	431.22	435.59	435.29	435.02	434.27	432.77	432.03	431.75	431.01	429.64	434.34	432.44

---- = not measured

Table 5-3 : Summary of Alluvial Aquifer Hydraulic Conductivity Values

Hydraulic Conductivity K (cm/s) *		
3.78E-03		
8.76E-04	Maximum	3.43E-02
3.43E-02	Minimum	8.76E-04
2.32E-03	Average	8.22E-03
4.17E-03		
3.83E-03		
3.27E-02		
5.41E-02	Maximum	6.68E-02
6.68E-02	Minimum	1.22E-02
5.47E-02	Average	4.45E-02
4.63E-02		
1.22E-02		
3.15E-02		
4.29E-02	Maximum	8.85E-02
4.14E-02	Minimum	4.50E-03
8.85E-02	Average	4.28E-02
4.50E-03		
4.78E-02		

Note: All hydraulic conductivity values were determined using the AQTESOLV™ computer program (Geraghty & Miller, 1989)

Table 6-1 : Summary of Radionuclide Occurrence Above Reference Levels in Area 1 Surface Samples

Radiological Constituents	Background Value (mean + 2 std. dev.)	> Background but < Reference		Reference Level	> Reference Level	
		# Detects	Range		# Detects	Range
Uranium – 238 Decay Series						
Uranium-238	2.24	1	2.33+/-0.54	7.24	2	87+/-7.2 to 147+/-38
Thorium-234	2.76	0		7.76	2	55.9+/-13.5 to 180+/-49
Uranium-234	2.73	1	2.94+/-0.65	7.73	2	105+/- 22 to 154+/-40
Thorium-230	2.45	1	2.67+/-0.76	7.45	2	7,850+/-1,470 to 57,000 +/-4,100
Radium-226	1.30	1	1.32+/-0.24	6.3	2	109+/-5 to 910+/-93
Lead-214	1.13	3	1.16+/-0.44 to 1.62+/-0.56	6.13	2	108+/-8 to 1,100+/-99
Bismuth-214	1.61	0		6.61	2	110+/-6 to 1,000+/-57
Lead-210	3.77	0		8.77	3	206+/-26 to 1,040+/-135
Uranium – 235 Decay Series						
Uranium-235/236	1.15	1	5.7+/-1.9	6.15	2	6.86+/-3.99 to 19.5+/-5.9
Proactinium-231	NE	NE	NE	5	2	156+/-27 to 610+/-110
Actinium-227	NE	NE	NE	5	2	118+/-14 to 305+/-33
Radium-223	NE	NE	NE	5	2	113+/-NA to 939+/-76
Thorium – 232 Decay Series						
Thorium-232	1.55	0		6.55	2	18.1+/-4.6 to 40+/-150
Radium-228	2.37	0		7.37	0	
Thorium-228	1.33	1	1.96+/-1.14	6.33	0	
Radium-224	NE	NE	NE	5	1	1,760+/-219
Lead-212	2.26	0		7.26	0	
Bismuth-212	NE	NE	NE	5	0	
Thallium-208	0.71	1	0.79+/-0.83	5.71	1	6.8+/-2.1

All values expressed as pCi/g.
NE = Not established, all background samples below minimum detectable activity. NA = 2 Sigma Error (+/-) is not available.
A total of 8 surface soil samples were collected in Area 1. One of the samples was split and analyzed at two different laboratories. For some of the radionuclides, the results from one of the laboratories were greater than the background or reference levels, while the results from the second laboratory were not.

Table 6-2 : Summary of Radionuclide Occurrence Above Reference Levels in Area 1 Subsurface Samples

Radiological Constituents	Background Value (mean + 2 std. dev.)	> Background but < Reference # Detects	Range	Reference Level	> Reference Level # Detects	Range
Uranium – 238 Decay Series						
Uranium-238	2.24	5	2.89+/-0.56 to 6.94+/-1.28	17.24	2	17.8+/-4.1 to 26.4+/-10.1
Thorium-234	2.76	0		17.76	0	
Uranium-234	2.73	6	2.92+/-1.46 to 15.6+/-3.6	17.73	0	
Thorium-230	2.45	6	2.47+/-1.26 to 7.52+/-1.65	17.45	6	23.2+/-4.9 to 1,500+/-240
Radium-226	1.30	6	1.36+/-0.37 to 6.3+/-1.2	16.3	3	18.4+/-1 to 128+/-6
Lead-214	1.13	12	1.13+/-0.33 to 7.0+/-0.76	16.13	3	19.9+/-1.6 to 110+/-7
Bismuth-214	1.61	3	2.53+/-0.19 to 6.5+/-0.58	16.61	3	18.4+/-1.2 to 128+/-7.00
Lead-210	3.77	2	5.1+/-1.0 to 17+/-4.0	18.77	2	83.4+/-12.4 to 212+/-28
Uranium – 235 Decay Series						
Uranium-235/236	1.15	1	1.46+/-0.57	16.15	0	
Proactinium-231	NE	NE	NE	15	3	26.9+/-7.9 to 73.2+/-14.6
Actinium-227	NE	NE	NE	15	3	15.0+/-2.6 to 43.8+/-5.8
Radium-223	NE	NE	NE	15	3	16.1+/-NA to 44.3+/-NA
Thorium – 232 Decay Series						
Thorium-232	1.55	4	1.64+/-0.56 to 10.3+/-3.5	16.55	0	
Radium-228	2.37	0		17.37	0	
Thorium-228	1.33	1	1.55+/-1.48	16.33	0	
Radium-224	NE	NE	NE	15	1	39.1+/-6.3
Lead-212	2.26	0		17.26	0	
Bismuth-212	NE	NE	NE	15	0	
Thallium-208	0.71	0		15.71	0	

All values expressed as pCi/g.
NE = Not established, all background samples below minimum detectable activity. NA = 2 Sigma Error (+/-) is not available.
A total of 39 subsurface soil samples were collected in Area 1. Field and laboratory duplicates were prepared for several of the samples. Two of the samples were split and analyzed at two different laboratories. For some of the radionuclides, the results from one of the laboratories or from one of the duplicate samples were greater than the background or reference levels, while the results from the original sample or second laboratory were not.

Table 6-3 : Summary of Radionuclide Occurrence Above Reference Levels in Area 2 Surface Samples

Radiological Constituents	Background Value (mean + 2 std. dev.)	> Background but < Reference # Detects	Range	Reference Level	> Reference Level # Detects	Range
Uranium 238 – Decay Series						
Uranium-238	2.24	3	3.1+/-0.7 to 4.17+/-1.04	7.24	2	134+/-42 to 294+/-92
Thorium-234	2.76	0		7.76	0	
Uranium-234	2.73	3	3.18+/-1.06 to 4.05+/-1.02	7.73	2	216+/-67 to 575+/-180
Thorium-230	2.45	4	2.91+/-0.82 to 5.35+/-1.14	7.45	9	8.63+/-2.62 to 29,240+/-5,290
Radium-226	1.30	4	1.54+/-0.22 to 4.78+/-0.44	6.3	4	9.2+/-1.7 to 3,720+/-142
Lead-214	1.13	5	1.28+/-0.28 to 5.26+/-0.49	6.13	4	8.8+/-1.0 to 3,190+/-277
Bismuth-214	1.61	2	3.56+/-0.87 to 4.2+/-0.67	6.61	4	7.3+/-0.69 to 3,690+/-136
Lead-210	3.77	0		8.77	3	9.58+/-2.32 to 1,370+/-162
Uranium – 235 Decay Series						
Uranium-235/236	1.15	0		6.15	2	49.7+/-16.5 to 251+/-79
Proactinium-231	NE	NE	NE	5	4	5.22+/-2.32 to 2,030+/-301
Actinium-227	NE	NE	NE	5	3	6.15+/-1.17 to 1,320+/-179
Radium-223	NE	NE	NE	5	3	6.73+/-NA to 1,097+/-NA
Thorium – 232 Decay Series						
Thorium-232	1.55	0		6.55	4	6.73+/-1.36 to 127+/-23
Radium-228	2.37	0		7.37	0	
Thorium-228	1.33	1	4.97+/-1.04	6.33	0	
Radium-224	NE	NE	NE	5	2	4,330+/-628 to 6,580+/-1090
Lead-212	2.26	0		7.26	0	
Bismuth-212	NE	0		5	0	
Thallium-208	0.71	0		5.71	0	

All values expressed as pCi/g.
NE = Not established, all background samples below minimum detectable activity. NA = 2 Sigma Error (+/-) is not available.
A total of 15 surface soil samples were collected in Area 2. Three of the samples were split and analyzed at two different laboratories. For some of the radionuclides, the results from one of the laboratories were greater than the background or reference levels, while the results from the second laboratory were not.

Table 6-4 : Summary of Radionuclide Occurrence Above Reference Levels in Area 2 Subsurface Samples

Radiological Constituents	Background Value (mean + 2 std. dev.)	Background but < Reference # Detects	Range	Reference Level	> Reference Level # Detects	Range
Uranium – 238 Decay Series						
Uranium-238	2.24	7	2.61+/-0.64 to 11.4+/-3.8	17.24	3	60.7+/-12.4 to 287+/-47
Thorium-234	2.76	1	13.2+/-15.7	17.76	2	24.5+/-15.8 to 140+/-25
Uranium-234	2.73	6	2.9+/-0.4 to 12.5+/-4.0	17.73	3	45.4+/-9.7 to 527+/-87
Thorium-230	2.45	28	2.72+/-1.45 to 17.29+/-3.4	17.45	18	18.2+/-3.3 to 83,000+/-530
Radium-226	1.30	17	1.3+/-0.45 to 12.9+/-0.54	16.3	4	88.4+/-5.2 to 3,140+/-116
Lead-214	1.13	23	1.14+/-0.24 to 12.5+/-0.9	16.13	4	85.9+/-6.4 to 2,200+/-170
Bismuth-214	1.61	10	1.63+/-0.42 to 12.6+/-0.6	16.61	4	93.2+/-5.1 to 3,150+/-111
Lead-210	3.77	7	4.02+/-1.6 to 9.83+/-2.56	18.77	6	22.4+/-3.5 to 1,300+/-157
Uranium – 235 Decay Series						
Uranium-235/236	1.15	0		16.15	3	24+/-27 to 115+/-19
Proactinium-231	NE	NE	NE	15	4	39.3+/-11.1 to 1,930+/-243
Actinium-227	NE	NE	NE	15	4	25.8+/-4.2 to 1,180+/-138
Radium-223	NE	NE	NE	15	4	30.2+/-NA to 5,270+/-359
Thorium – 232 Decay Series						
Thorium-232	1.55	4	1.76+/-1.07 to 3.84+/-0.9	16.55	3	106+/-19 to 180+/-65
Radium-228	2.37	2	14.5+/-7.9 to 16.7+/-9.3	17.37	0	
Thorium-228	1.33	2	1.5+/-0.80 to 4.59+/-0.91	16.33	0	
Radium-224	NE	NE	NE	15	0	
Lead-212	2.26	1	2.49+/-0.94	17.26	1	82+/-35
Bismuth-212	NE	NE	NE	15	0	
Thallium-208	0.71	3	1.13+/-0.78 to 7.9+/-3.7	15.71	0	

All values expressed as pCi/g.
NE = Not established, all background samples below minimum detectable activity. NA = 2 Sigma Error (+/-) is not available.
A total of 73 subsurface soil samples were collected in Area 2. Field and laboratory duplicates were prepared for several of the samples. Four of the samples were split and analyzed at two different laboratories. For some of the radionuclides, the results from one of the laboratories or from one of the duplicate samples were greater than the background or reference levels, while the results from the original sample or second laboratory were not.

Table 6-5 : Summary of Background Radionuclide Levels at the West Lake Landfill

Radionuclide	Detection Frequency	Mean	Standard Deviation	Minimum Value	Maximum Value	Mean Plus 2 Standard Deviations	Mean Plus 3 Standard Deviations	Variance
Uranium-238 Decay Series								
Uranium-238	4/4	1.33	0.46	0.74+/-0.35	1.85+/-0.79	2.24	2.7	0.21
Thorium-234	2/4	1.57	0.59	1.15+/-0.89	1.99+/-1.11	2.76	3.35	0.35
Uranium-234	4/4	1.47	0.63	1.06+/-0.44	2.40+/-0.93	2.73	3.36	0.40
Thorium-230	4/4	1.51	0.47	0.92+/-0.44	2.03+/-0.6	2.45	2.91	0.22
Radium-226	4/4	1.06	0.12	0.95+/-0.22	1.19+/-0.22	1.30	1.41	0.01
Lead-214	4/4	1.01	0.06	0.92+/-0.26	1.07+/-0.24	1.13	1.19	0.004
Bismuth-214	2/4	1.09	0.26	0.90+/-0.31	1.27+/-0.4	1.61	1.87	0.07
Lead-210	3/4	2.48	0.64	1.88+/-1.56	3.16+/-2.18	3.77	4.41	0.41
Uranium-235 Decay Series								
Uranium-235/236	4/4	0.39	0.38	0.02+/-0.08	0.91+/-0.57	1.15	1.54	0.15
Uranium-235	--	--	--	--	--	--	--	--
Protactinium-231	--	--	--	--	--	--	--	--
Actinium-227	--	--	--	--	--	--	--	--
Radium-223	--	--	--	--	--	--	--	--
Thorium-232 Decay Series								
Thorium-232	4/4	0.90	0.33	0.52+/-0.29	1.26+/-0.39	1.55	1.87	0.11
Radium-228	2/4	1.65	0.36	1.39+/-0.4	1.90+/-0.47	2.37	2.73	0.13
Thorium-228	4/4	0.68	0.33	0.43+/-0.27	1.16+/-0.37	1.33	1.66	0.11
Radium-224	--	--	--	--	--	--	--	--
Lead-212	4/4	1.29	0.48	0.80+/-0.31	1.94+/-0.29	2.26	2.74	0.23
Bismuth-212	--	--	--	--	--	--	--	--
Thallium-208	4/4	0.44	0.14	0.32+/-0.16	0.63+/-0.21	0.71	0.84	0.02

All values expressed as pCi/g, except detection frequency.

Four background samples were analyzed. Samples without detections were not used to calculate background statistics.

-- = Radionuclides were not detected above the Minimum Detectable Activity (MDA) in any of the four background samples.

Table 6-6 : Background Gamma and Radionuclide Concentrations in Surface Soil Samples in the State of Missouri

Sample Designation/ Location	Gamma Exposure Rate (uR/hr)	Surface Soil Radionuclide Concentration (pCi/g) U-238	Ra-226	Th-232
West Lake Landfill - McLaren/Hart				
Barrow Pit - loess	13.5	1.3+/-0.50	1.19+/-0.22	0.75+/-0.38
Barrow Pit - shale	16.3	1.85+/-0.79	0.97+/-0.2	1.26+/-0.39
Farmer's Field	13.7	1.41+/-0.5	1.13+/-0.25	1.05+/-0.38
McLaren/Hart Shop	10.1	0.74+/-0.35	0.95+/-0.22	0.52+/-0.29
Mean	13.4	1.3	1.1	0.9
Standard Deviation(S)	2.6	0.5	0.1	0.3
Mean + 2S	18.5	2.2	1.3	1.5
State of Missouri - Bechtel National, Inc				
MO-1	6.0	1.7	1.4	1.3
MO-2	10.0	1.3	1.3	1.2
MO-3	6.7	1.2	1.1	1
MO-4	7.5	1.1	1.3	1.1
MO-5	8.1	1.3	1.2	1.2
MO-6	5.4	0.33	0.31	0.32
MO-7	7.6	1.1	1.1	1.1
MO-8	6.8	0.81	0.83	0.76
MO-9	5.1	1.1	1.1	1.1
MO-10	4.6	0.76	1	0.95
Mean	6.8	1.1	1.1	1.0
Standard Deviation(S)	1.6	0.4	0.3	0.3
Mean + 2S	10.0	1.8	1.7	1.6
5-Mile Radius of Weldon Spring Site - UNC-Geotech				
1	10.0	1	0.8	0.9
2	10.3	0.7	1.1	1.5
3	9.2	0.7	1.2	1.3
4	9.2	0.7	1.1	1.1
5	11.0	1.3	1.3	1.1
6	10.5	1	1.3	1
7	10.7	1.7	1.2	1.4
8	10.5	1.7	1.3	1.1
Mean	10.2	1.1	1.2	1.2
Standard Deviation(S)	0.7	0.4	0.2	0.2
Mean + 2S	11.5	1.9	1.5	1.6

Table 6-6 : Background Gamma and Radionuclide Concentrations in Surface Soil Samples in the State of Missouri (cont.)

Sample Designation/ Location	Gamma Exposure Rate (uR/hr)	Surface Soil Radionuclide Concentration (pCi/g) U-238	Ra-226	Th-232
5-Mile Radius of Weldon Spring Site - Project Management Contractor				
1	9.3	<1.9	0.8	0.8
2	9.0	<1.9	1.1	0.9
3	8.9	<1.8	1.3	0.6
4	9.5	<1.9	0.8	0.8
5	9.2	<2.0	0.9	1
6	9.5	<1.9	1.1	1
Mean	9.2	NA	1.0	0.9
Standard Deviation(S)	0.3	NA	0.2	0.2
Mean + 2S	9.7	NA	1.4	1.2
USING ALL AREAS				
Mean	9.2	1.1	1.1	1.0
Standard Deviation(S)	2.6	0.4	0.2	0.3
Mean + 2S	14.4	1.9	1.5	1.5

< indicates that the sample result is below the Method Detection Activity (MDA), with the number indicating the MDA

Table 6- 7: Summary of Area 1 Downhole Gamma Log Results

Boring No.	Downhole Gamma Peak Depth (ft)	Downhole Gamma Peak Intensity (cpm)	Comments
WL-101	-	-	No peak
WL-102	3	58,000	
WL-103	-	-	No peak
WL-104	-	-	No peak
WL-105	9	180,000	At location of well D-5
Well I-4	6.5	260,000	Adjacent to boring WL-105
Well S-5	3.5	387,000	Adjacent to boring WL-105
WL-106	4	25,000	Poorly defined peak
WL-107	-	-	No peak
WL-108	-	-	No peak
WL-109	-	-	No peak
WL-110	-	-	No peak
WL-111	-	-	No peak
WL-112	6	10,000	Poorly defined peak
WL-113	4	13,000	Poorly defined peak
WL-114	5	15,000	Poorly defined peak
WL-115	-	-	No peak
WL-116	-	-	No peak
WL-117	6.5	16,000	Poorly defined peak
WL-118	0	12,000	Poorly defined peak
WL-119	-	-	No peak
WL-120	-	-	No peak
PVC-24	-	-	No peak
PVC-25	9	70,000	
PVC-26	5	85,000	
PVC-27	-	-	No peak
PVC-28	14	130,000	
PVC-36	8	15,000	Poorly defined peak
PVC-37	-	-	No peak
PVC-38	10	1,298,000	
PVC-41	-	-	No peak

cpm – counts per minute

Table 6-8: Summary of Estimated Thicknesses of Subsurface Radiologically Impacted Materials in Area 1

Boring	Estimated Total Thickness of Radiologically Impacted Materials (ft)	Surface Materials Present ?	Subsurface Thickness (Adjusted for Surface Thickness) (ft)
WL-102	2	no	2
WL-105	10	yes	9.5
Well S-5	4	no	4
Well I-4	4	no	4
WL-106	3	no	3
WL-112	2	no	2
WL-113	2	no	2
WL-114	1	no	1
WL-117	1	no	1
WL-118	1.5	yes	1
PVC-25	2	no	2
PVC-26	2	no	2
PVC-28	2	no	2
PVC-36	2	no	2
PVC-38	12	yes	11.5
Average	3.37		3.27
Std. Dev.	3.13		2.99

Table 6-9: Summary of Area 2 Downhole Gamma Log Results

Boring No.	Gamma Peak Depth (ft)	Gamma Peak Intensity (cpm)	Comments
WL-207	-	-	No peak
WL-208	-	-	No peak
WL-209	1	740,000	
WL-210	0 and 48?	506,000 and 90,000?	Note 1
WL-211	1	330,000	
WL-212	-	-	No peak
WL-213	-	-	No peak
WL-214	-	-	No peak
WL-216	3.5	24,000	Poorly defined peak
WL-217	-	-	No peak
WL-218	-	-	No peak
WL-219	-	-	No peak
WL-220	-	-	No peak
WL-222	-	-	No peak
WL-223	4	15,000	Poorly defined peak
WL-224	-	-	No peak
WL-225	-	-	No peak
WL-226	11	370,000	
WL-227	-	-	No peak
WL-228	-	-	No peak
WL-229	-	-	No peak
WL-230	1.5	10,000	Poorly defined peak
WL-231	5.5	27,000	
WL-232	-	-	No peak
WL-233	22	89,000	
WL-234	7	1,104,000	
WL-235	22.5 ?	20,000	Note 2
WL-236	-	-	No peak
WL-237	-	-	No peak
WL-238	6	130,000	
WL-239	-	-	No peak
WL-240	-	-	No peak
WL-241	5.5	45,000	
PVC-4	1	1,290,000	
PVC-5	6 and 11	15,000 ?	Very poorly defined peaks
PVC-6	9.5 and 11	346,000 and 369,000	Overall one peak w/ 2 sub-peaks
PVC-7	2 and 19.5	1,385,000 and 21,000	Note 2
PVC-8	1	23,000	
PVC-9	5	22,000	Very poorly defined peak
PVC-10	3 and 10	753,000 and 152,000	
PVC-11	3	2,288,000	
PVC-12	2.5	57,000	
PVC-13	-	-	No peak
PVC-18	-	-	No peak
PVC-19	8	330,000	
PVC-20	1.5	126,000	
PVC-33	2.5	10,000	No peak? - very poorly defined
PVC-34	1	22,000	Very poorly defined peak
PVC-35	4	745,000	
PVC-39	2.5	14,000	Poorly defined peak
PVC-40	2.5 and 7	120,000 and 46,000	

Note 1: Lower peak due to material knocked down hole during drilling/logging
Note 2: Lower peak at bottom of hole possibly from material knocked down hole during drilling/lgging

Table 6-10: Summary of Estimated Thicknesses of Subsurface Radiologically Impacted Materials in Area 2

Boring	Estimated Total Thickness of Radiologically Impacted Materials (ft)	Surface Materials Present ?	Subsurface Thickness (Adjusted for Surface Thickness) (ft)
WL-209	5	yes	4.5
WL-210	6	yes	5.5
WL-211	3	yes	2.5
WL-216	4	no	4
WL-223	3	no	3
WL-226	1	no	1
WL-226	8	no	8
WL-230	3	yes	2.5
WL-231	5	no	5
WL-233	4	no	4
WL-234	10	no	10
WL-235	3	no	3
WL-238	4	no	4
WL-241	4.5	no	4.5
PVC-4	4.5	yes	4
PVC-5	1	no	1
PVC-6	5	no	5
PVC-7	6	no	6
PVC-7	1	no	1
PVC-8	1	yes	0.5
PVC-9	1.5	no	1.5
PVC-10	5.5	no	5.5
PVC-10	2	no	2
PVC-11	5.5	yes	5
PVC-12	3	no	3
PVC-19	4	no	4
PVC-20	3	no	3
PVC-33	1	no	1
PVC-34	3	yes	2.5
PVC-35	5	no	5
PVC-39	2.5	no	2.5
PVC-40	2.5	no	2.5
PVC-40	2.5	no	2.5
Average	3.73		3.61
Std. Dev.	2.03		2.03

Table 6-11 : Summary of Elevated Downhole Gamma Levels, Soil Samples Above Reference Levels and Boring Log Descriptions

					Soil Analytical Data																			
					U-238 Decay Series								U-235 Decay Series					Th-232 Decay Series						
Boring No	Peak Gamma Log Depth (ft)	Gamma Log Reading (CPM)	Soil Sample Depth (ft)	Description of Material at Depth of Concern from Soil Boring Log	U-238	Th-234	U-234	Th-230	Ra-226	Pb-214	Bi-214	Lead-210	U-235/236	U-235	Pa-231	Ac-227	Ra-223	Th-232	Ra-228	Th-228	Ra-224	Pb-212	Bi-212	Tl-208
WL-102	3.5	60,000		Landfill Debris: trashy debris consisting of wood, plastic, glass, and wire; soil consisting of olive gray silt and dark gray, silty, plastic clay to grayish brown, silty sand and crushed rock; dry to moist.																				
		8,000	5		0.88	<1.16	1.06	4.18	1.17	1.56	<0.63	1.49	<0.16	<0.49	<3.79	<0.74	<8.77	0.9	<0.99	1.05	3.0	0.97	<1.53	<0.28
WL-105	9	180,000		Landfill Debris: trashy debris consisting of cloth, wood, rope, and plastic; soil consisting of brown and gray silt, and and crushed rock; dry to moist.																				
WL-105D	9	52,000																						
		28,000	10		6.94	<5.05	6.64	522	40.8	40	40.2	83.4	0.55	3.95	26.9	15.0	16.8	4.34	<1.59	<2.18	<11.75	<0.73	<2.82	<0.39
WL-106		<6,000	0	Landfill Debris: trashy debris consisting of wood, plastic, glass, and wire; soil consisting of dark gray silt to clayey silt, and crushed rock; dry to moist.	105	<18.75	105	9,700	906	650	908	1040	6.86	75.5	544	305	293	35.2	<5.86	<7.89	1,760	<2.9	<10.2	<1.32
	4	25,000																						
		10,000	5		6.69	<2.76	11.5	731	18.8	19.1	18.1	47.5	<3.87	2.1	11.1	6.3	6.67	3.22	1.42	0.29	<7.3	0.77	<1.99	0.42
		10,000	5 DUP(F)		26.4	<8.02	<35.3	766	128	110	128	212	<25.5	12.1	73.2	43.8	44.3	4.71	<2.69	0.39	<20.49	<1.17	4.5	<0.63
WL-112		8,000	5	Landfill Debris: trashy debris consisting of yard waste, wood, plastic, cloth, paper, wire, and metal; soil consisting of grayish brown to dark gray silt, dark gray to grayish brown clayey silt, and very fine-grained sand; dry to wet.	3.44	<2.55	2.92	84.4	4.66	5.14	4.35	11.2	0.24	<0.85	<5.45	<1.32	<16.78	<1.56	<1.2	1.55	<6.16	1.08	<2.02	0.43
	6.5	10,000																						
WL-113	4	14,000		Landfill Debris: trashy debris consisting of yard waste, wood, plastic, cloth, paper, wire, and metal; soil consisting of dark gray to grayish brown silty clay and very fine to medium-grained sand; dry to wet.																				
		7,000	5		1.25	0.58	1.4	0.33	0.97	0.88	1.06	<1.26	0.6	<0.23	<1.01	<0.32	<3.26	0.19	1.06	0.21	3.49	1.04	0.80	0.36
		7,000	5 DUP(F)		0.62	0.83	0.76	0.58	1.06	1.05	1.06	1.41	<0.19	<0.17	<0.72	<0.17	<2.88	0.15	0.98	<0.14	2.86	1.00	1.06	0.31
WL-114		<6,000	0	Landfill Debris: trashy debris consisting of yard waste, wood, plastic, cloth, paper, insulation, wire, and metal; soil consisting of dark gray to grayish brown clayey silt and very fine to medium-grained sand; dry to wet.	147	55.9	154	7,853	109	108	110	206	19.5	17.6	156	118	113	18.1	<2.5	1.96	<12.42	<1.85	<3.9	0.79
	5	16,000	5		3.54	<0.73	3.43	23.2	2.59	2.52	2.6	3.29	0.82	0.32	1.93	1.2	<4.77	<0.26	0.39	0.33	6.15	0.43	<0.35	0.16
WL-117	6.5	16,000		Landfill Debris: trashy debris consisting of yard waste, wood, wire, insulation, plastic, cloth, paper, and metal; soil consisting of dark gray silty clay; dry to wet.																				
		<6,000	10		2.9	1.44	1.72	36.58	3.15	2.92	3.22	5.82	<0.25	0.3	<1.45	0.79	1.03	1	0.64	0.47	6.48	0.58	<0.4	0.16
WL-118		<6,000	5	Landfill Debris: trashy debris consisting of plastic, cloth, paper, glass, and metal; soil consisting of light brown to dark gray, silty, plastic clay; dry to moist.	17.8	<5.05	15.6	425	18.4	19.9	18.4	<40.3	1.46	2.4	28.3	18.5	16.1	10.3	<0.73	<1.99	39.1	<0.55	<1.33	<0.17
WL-206		<6,000	0	Native Alluvium: olive brown clayey silt grading to grayish brown, coarse-grained sand and gravel; dry to wet.	4.17	<2.53	4.05	429	17.2	18.0	17.4	49.6	<0.33	1.7	7.93	6.15	6.73	11.2	<1.21	1.01	<7.31	1.09	<2.44	0.34
WL-208		<6,000	5	Landfill Debris: trashy debris consisting of wood, brick, paper, concrete, insulation, metal, plastic, glass, and wire; soil consisting of dark gray silty clay to medium-grained sand, and rock; dry to moist.	1.6	<3.92	2.05	123	3.26	3.39	3.05	<26.9	0.16	<1.18	<5.9	<1.22	<10.24	1.43	0.68	0.96	<5.15	0.48	<1.23	<0.27
		<6,000	5 DUP(L)		2.82	2.64	2.27	94.9	3.40	3.29	3.36	7.37	0.03	<1.04	<5.56	1.40	<7.64	0.82	<1.03	0.7	<4.77	0.84	<1.75	0.38
WL-209	0.5	744,000	0	Landfill Debris: trashy debris consisting of rubber, brick, concrete, insulation, metal, wood, plastic, glass, and wire; soil consisting of dark gray clayey silt to fine-grained sand, and rock; dry to moist.	294	<93.3	575	29,240	3,720	3,190	3,690	<1170	251	263	2,030	1,320	1,097	127	<21.34	4.97	6,580	<13.8	<40.36	<5.77
		44,000	5		249	<66.82	335	38,280	2,970	685	3,000	<810	72.4	74.8	1,930	1,180	900	138	<16.34	<40.1	<123.9	<8.56	<30.1	<4.28
		44,000	5 DUP(F)		287	49.4	527	32,680	3,140	1,080	3,150	1,170	115	62.6	1,200	1,070	982	180	16.7	<61.7	<93.04	<3.83	<20.68	4.27
		<6,000	25		0.58	<3.07	0.46	26.9	0.85	0.91	0.78	<26.9	<0.17	<0.84	<4.81	<0.86	<8.56	0.71	<0.92	0.38	<3.79	0.52	<1.41	0.22
		<6,000	25 DUP(F)		0.61	<1.28	0.59	12.85	0.62	0.61	<0.50	2.94	<0.12	<0.70	<3.65	<1.06	<7.65	<0.84	<0.85	<1.26	2.68	0.52	<1.15	0.19
WL-210		420,000	0	Landfill Debris: trashy debris consisting of wood, plastic, paper, shredded tires, yard waste, cloth, metal, glass, and wire; soil consisting of dark gray to brown silt and fine grained sand, and crushed rock; dry to wet.	134	<29.51	216	18,190	2,280	1,450	2,300	1,370	49.7	182	838	732	660	59.2	<9.55	<13.5	4,330	<4.7	<17.29	<2.34
	0.25	509,000																						
		88,000	5		65.5	<32.11	145	12,400	520	546	512	<372	15.5	<10.12	348	220	171	106	<6.72	3.88	<0.52	<3.64	<12.76	<1.78
		88,000	5 DUP(F)		128	13.2	267	15,610	458	368	468	583	43.8	27.2	164	156	147	120	<4.66	4.59	<36.13	2.49	<7.93	1.13
	11.5	25,000																						
		<6,000	40		0.91	<1.25	0.69	18.2	0.68	0.8	0.62	<1.9	<0.15	<0.78	<4.2	<1.07	<8.18	0.37	<0.83	0.65	3.00	0.61	<1.19	<0.15
		<6,000	40 DUP(F)		0.54	<3.94	0.93	10.8	1.66	1.82	1.4	<57.9	0.25	<1.5	<8.24	<1.73	<13.95	0.82	<1.45	0.4	<5.84	0.43	<2.27	<0.4

Table 6-11 : Summary of Elevated Downhole Gamma Levels, Soil Samples Above Reference Levels and Boring Log Descriptions

Boring No.	Peak Gamma Log Depth (ft)	Gamma Log Reading (CPM)	Soil Sample Depth (ft)	Description of Material at Depth of Concern from Soil Boring Log	U-238 Decay Series: U-238	Th-234	U-234	Th-230	Ra-226	Pb-214	Bi-214	Lead-210	U-235 Decay Series: U-235/236	U-235	Pa-231	Ac-227	Ra-223	Th-232 Decay Series: Th-232	Ra-228	Th-228	Ra-224	Pb-212	Bi-212	Tl-208
WL-211	0.75 9.5	330,000 20,000 15,000	5	Landfill Debris: trashy debris consisting of wood, plastic, paper, rubber, metal, and concrete; soil consisting of grayish-brown sandy and silty clay to coarse-grained sand; dry to wet.	2.61	<1.98	2.3	66.11	8.52	8.47	8.01	22.4	0.22	<0.75	<5.46	2.48	<9.08	1.38	<1.15	0.66	<5.48	0.99	<1.73	<0.21
WL-212		<6,000	10	Landfill Debris: trashy debris consisting of wood, plastic, brick, paper, rubber, insulation; soil consisting of dark gray silty clay, silt, and very fine-grained sand, and crushed rock; dry to moist.	1.77	<1.19	1.86	116	1.77	1.95	1.63	4.02	<0.16	<0.56	<3.71	<0.78	<8.69	0.9	<0.90	0.55	3.66	0.47	<1.6	<0.16
WL-213		<6,000 <6,000 <6,000	0 5 25	Landfill Debris: trashy debris consisting of wood, plastic, brick, cardboard, paper, wire, rubber, metal; soil consisting of dark gray silty clay and black, sandy, clayey silt to dark gray, silty very fine-grained sand and crushed rock; dry to moist.	1.53 1.53 0.45	2.05 <3.50 <3.63	1.64 1.00 1.06	24.2 17.29 3.13	1.00 1.26 0.93	1.28 1.32 1.06	<0.70 <0.63 <0.85	2.36 <26.9 <50.3	0.45 <0.15 <0.17	<0.88 <0.83 <1.35	<5.11 <4.84 <7.02	<1.03 <1.01 <1.59	<18.42 <9.36 <15.23	1.11 0.89 0.52	<0.9 <0.92 <1.49	0.79 0.67 0.64	<4.09 <4.14 <5.23	<0.37 0.63 <0.4	<1.54 <1.48 <2.76	<0.22 <1.65 0.37
WL-214		<6,000 <6,000	5 25	Landfill Debris: trashy debris consisting of shingles, carpeting, glass wood, plastic, brick, paper, wire, and metal; soil consisting of dark gray clayey silt to fine-grained sand; dry to moist.	0.81 0.67	1.14 <3.23	1.09 0.97	44.4 12.8	0.95 <0.52	1.01 0.74	<0.62 <0.52	<1.23 <26.9	0.81 <0.15	<0.52 <0.89	<3.52 <4.33	<0.55 <0.99	<7.54 <9.51	0.41 0.36	<0.81 <0.89	0.5 0.48	<2.31 <4.23	0.62 0.80	<1.34 <1.37	0.24 0.32
WL-216	3.5	48,000 11,000	5	Landfill Debris: trashy debris consisting of plastic, cloth, and glass; soil consisting of grayish brown to olive brown silty clay to gray, very fine-grained sand, and limestone rock; dry to moist.	11.4	<7.06	12.5	1,131	88.4	85.9	93.2	176	<2.36	<3.07	39.3	25.8	30.2	3.05	<2.21	<1.14	<18.28	<1.07	<4.26	<0.55
WL-222		<6,000 <6,000	0 5	Landfill Debris: trashy debris consisting of plastic, cloth, paper, carpeting, wood, and metal; soil consisting of dark gray to black clay and silty clay to dark gray, silty, fine-grained sand; dry to moist.	3.36 1.21	<5.69 1.41	2.26 1.46	131 81.4	2.94 1.80	2.41 1.85	3.56 1.81	<69.0 4.45	0.69 <0.12	<1.99 <0.64	<11.4 <4.19	<2.48 0.69	<44.46 <20.40	1.31 1.3	<1.75 0.83	0.97 0.89	<8.22 4.71	<0.53 0.78	<2.91 <1.73	<0.45 <0.16
WL-223	4	15,000 14,000	5	Landfill Debris: trashy debris consisting of wire, wood, plastic, cloth, rubber,and paper; soil consisting of brownish yellow silt to dark gray silty clay and silty fine-grained sand; dry to moist.	1.22	<1.82	1.44	9.16	1.73	1.77	1.82	<2.15	<0.14	<0.75	<5.18	<1.33	<17.03	0.64	<1.14	0.36	<4.57	0.83	<1.64	0.31
WL-226	3 10.5	20,000 290,000 370,000 <6,000	10 20	Landfill Debris: trashy debris consisting of wood, rubber, wire, plastic, cloth, and paper; soil consisting of dark gray, slightly sandy, clayey silt to fine-grained sand; dry to moist.	1.63 6.32	<2.17 2.55	1.38 6.02	14.1 173	1.4 3.26	1.4 3.26	1.25 <1.21	4.35 5.93	0.39 <1.19	<0.8 <0.87	<5.14 <7.51	<1.2 <1.47	<21.54 <28.91	<0.85 <0.85	0.95 <1.12	<1.12 <0.99	<4.82 <5.32	1.38 <0.39	<1.85 <2.05	0.30 <0.25
WL-227		<6,000	5	Landfill Debris: trashy debris consisting of wood, rubber, plastic, cloth, glass, carpeting, metal, and paper; soil consisting of brown and dark gray silty clay to dark gray fine-grained sand; dry to wet.	2.01	<1.53	1.68	20.4	1.32	1.38	0.92	2.35	<0.63	<0.66	<3.96	<0.72	<16.05	<0.53	1.35	<0.84	3.48	1.03	<1.76	0.23
WL-230	1.5	10,000 <6,000	5	Landfill Debris: trashy debris consisting of plastic, cloth, wire, glass, carpeting, metal, and paper; soil consisting of olive brown silt, dark gray clayey silt, and dark gray, silty, fine-grained sand; dry to wet.	0.92	<2.05	2.23	26.8	1.67	1.56	1.93	2.26	0.48	<0.63	<4.86	<0.92	<17.88	<0.87	<1.16	<1.29	<3.92	0.88	<2.00	0.31
WL-231	5.5	18,000 29,000	5	Landfill Debris: trashy debris consisting of plastic, cloth, glass, and paper; soil consisting of brownish gray silt, dark gray and black clayey silt to dark gray, silty, fine-grained sand, and crushed rock; dry to wet.	3.86	2.48	6.97	94.5	4.06	3.96	4.18	5.59	<3.37	<0.73	<4.56	1.86	<19.43	1.11	<1.02	<1.26	<3.95	0.70	<1.60	<0.28
WL-233	22	90,000 <6,000	27	Landfill Debris: trashy debris consisting of wood, plastic, cloth, wire, limestone, rubber, metal, and paper; soil consisting of gray clay, dark gray to black silt, and dark gray, silty, fine-grained sand; dry to moist.	4.48	2.03	4.58	427	4.44	4.26	4.43	9.83	<2.32	<1.02	<6.54	1.44	<20 81	1.19	<1.11	<1.02	7.35	<2.87	<1.80	<0.24
WL-234	7	1,104,000 132000 132,000	10 10 DUP(F)	Landfill Debris: trashy debris consisting of wood, plastic, and glass; soil consisting of brown silt, dark gray clayey silt and silty clay to dark gray,silty, fine-grained sand and crushed rock; dry to moist.	138 60.7	24.5 <14.65	128 45.4	57,300 12,000	3,060 1,260	1,100 592	3,060 1,260	1,300 839	10.9 9.55	774 97.6	1,050 460	952 397	891 380	<240 <98.7	14.5 <6.62	<196 <132	<87.47 <56.24	10.8 <2.19	<18.63 <11.82	3.09 <1.51

Table 6-11 : Summary of Elevated Downhole Gamma Levels, Soil Samples Above Reference Levels and Boring Log Descriptions

					Soil Analytical Data: U-238 Decay Series								U-235 Decay Series					Th-232 Decay Series						
Boring No.	Peak Gamma Log Depth (ft)	Gamma Log Reading (CPM)	Soil Sample Depth (ft)	Description of Material at Depth of Concern from Soil Boring Log	U-238	Th-234	U-234	Th-230	Ra-226	Pb-214	Bi-214	Lead-210	U-235/236	U-235	Pa-231	Ac-227	Ra-223	Th-232	Ra-228	Th-228	Ra-224	Pb-212	Bi-212	Tl-208
WL-235		<6,000	0	Landfill Debris: trashy debris consisting of wood, metal, paper, wire, cloth, insulation, plastic, and glass; soil consisting of dark gray silty clay to clayey and silty, fine-grained sand; dry to wet.	0.77	<1.82	0.97	**12.4**	0.90	0.94	<0.61	1.56	<0.49	<0.56	<3.69	<0.70	<17.28	1.03	1.19	0.60	3.40	1.09	<1.76	0.46
		<6,000	5		0.91	<4.87	1.47	3.21	0.74	<0.86	-0.92	<59.3	<0.92	<1.63	<8.84	<2.28	<29.14	<0.83	<1.58	1.2	<7.2	1.10	<2.99	0.60
	22.5	20,000																						
	No gamma log		30		1.31	<2.09	1.25	3.15	1.09	1.18	1.00	<2.06	<0.3	<0.84	<4.88	<1.2	<15.87	<0.94	<0.93	<0.87	3.11	0.75	<1.68	<0.28
WL-238	6	130,000	no data	Landfill Debris: trashy debris consisting of wood, shredded tires, and wire; soil consisting of brown silt and dark gray fine-grained sand; dry to moist.																				
??WL-241		31,000	5	Landfill Debris: trashy debris consisting of glass, insulation, wood, cardboard, paper, wire, rubber, plastic, and wood; soil consisting of dark gray clay and silty clay to silty fine-grained sand, and crushed rock; dry to wet.	3.9	<0.94	4.51	**343**	12.9	12.5	12.6	**26.7**	0.23	<0.38	4.09	4.22	<5.35	3.84	<0.24	0.39	<2.14	<0.88	<0.42	0.28
	5.5	46,000																						
WL-242	No gamma log		0		1.63	<3.85	1.83	**8.63**	1.57	1.59	1.48	<29.8	0.4	--	<5.12	<1.24	<31.72	<0.34	<0.77	<1.1	<4.25	<0.28	<1.63	<0.24
	Surface sample		2		0.75	<4.91	1.35	**21.3**	2.42	2.45	<1.24	<66.3	0.56	--	<9.23	<2.36	<52.37	<0.75	<1.57	<1.19	<7.62	0.51	<2.73	<0.43
WL-243	No gamma log		0		3.63	<1.94	3.99	**265**	4.78	5.26	4.2	**9.58**	0.58	--	**5.22**	3.58	<25.10	**6.73**	3.13	1.11	<4.33	1.04	<1.8	0.46
	Surface sample																							
WL-244	No gamma log		0		1.65	<1.24	0.88	**20.8**	1.54	1.58	1.31	2.02	0.09	--	<4.57	0.81	<26.64	0.78	<1.05	<1.23	<2.24	0.86	<1.43	0.23
	Surface sample																							
PVC-4	1	1,290,000	1		**530**				**2,500**	**2,100**	**1,700**						**980**							
			10						2.5	2.7	2.8						0.83							
	11.5	14,000																						
			14						1.7	1.7	1.6						0.7							
PVC-5			4						3.4	3.7	3.1													
	5.5	15,000																						
			6						1.7	1.5	1.9											0.92		
			10						4.3	4.3	4.3											2.0		
	11.5	14,000																						
			12						2.1	1.9	2.3													
PVC-6			9						**40**	**40**	**41**						**36**							
	9.5	348,000																						
			10						**63**	**58**	**53**						**41**							
	11	367,000	11						**230**	**360**	**280**						**200**							
			12		**44**				**110**	**99**	**91**						**39**							
	20.5	23,000																						
PVC-7	3	1,386,000	--																					
	19.5	22,000	--																					
PVC-8			0						3.4	3.7	4.0						1.5					0.49		
	0.5	24,000																						
			2						1.3	1.4	1.5													
PVC-9			2		**46**				**55**	**56**	**56**						**35**							
			3						6.5	5.4	4.2													
			4						1.4	1.3	1.3													
	5	22,000																						
			6						0.56	0.7	0.84													
PVC-10	3	752,000	3						**520**	**480**	**440**													
			8						15	13	11											0.24		
	9.5	152,000																						
			10		**73**				**100**	**120**	**130**						**70**							
PVC-11			2		**2,900**				**13,000**		**13,000**													
PVC-11A	2.5	2,286,000																						
PVC-11B	2.5	2,146,000																						
			3						**1,700**	**1,100**	**200**													
PVC-12	2.5	58,000	--																					
PVC-19	8	332,000	8		**42**				**340**	**340**	**340**						**230**							
PVC-20			1						**76**	**72**	**68**						**43**							

Table 6-11 : Summary of Elevated Downhole Gamma Levels, Soil Samples Above Reference Levels and Boring Log Descriptions

Boring No.	Peak Gamma Log Depth (ft)	Gamma Log Reading (CPM)	Soil Sample Depth (ft)	Description of Material at Depth of Concern from Soil Boring Log	Soil Analytical Data U-238 Decay Series U-238	Th-234	U-234	Th-230	Ra-226	Pb-214	Bi-214	Lead-210	U-235 Decay Series U-235/236	U-235	Pa-231	Ac-227	Ra-223	Th-232 Decay Series Th-232	Ra-228	Th-228	Ra-224	Pb-212	Bi-212	Tl-208
	1.5	127,000																						
			2						17	14	9.9						2.9							
PVC-25	9	72,000	--																					
PVC-26	5	86,000	--																					
PVC-28	14	132,000	--																					
PVC-33	2.5	10,000	--																					
PVC-34	1	22,000	--																					
PVC-35	4	745,000	--																					
PVC-36	8	17,000	--																					
PVC-38	10	1,298,000	--																					
PVC-39	2.5	14,000	--																					
PVC-40	2.5	120,000	--																					
	7	46,000	--																					

Notes: Soil analytical data expressed as pCi/g. 2 Sigma Errors associated with these data are included in Appendix B.
< indicates sample result is below specific Method Detection Activity (MDA).
Red indicates an activity above the reference level.
[a] represents results of second downhole gamma survey, after soil that was accidently kicked into the boring was extracted.
-- indicates not reported.
Results shown on this table for the PVC borings include downhole gamma log results collected by McLaren/Hart in 1995 and radionuclide analytical data from Table 5 of the report "Radiological Survey of the West Lake Landfill", May 1982, Radiation Management Corp (RMC). The PVC borings were drilled, gamma-logged, and sampled in 1982 by RMC and re-logged in 1995 by McLaren/Hart. Some settling may have occurred in the PVC borings, potentially resulting in a shift in the gamma peak relative to the soil sample results.

Table 6-12 : Summary of Estimated Areal Extent and Volume of Radiologically Impacted Materials at the West Lake Landfill

Location	Areal Extent (ft^2)	Areal Extent (acres)	Volume (yd^3)
Area 1			
Surface	50,659	1.16	940
Subsurface	193,915	4.45	23,490
Area 1 Total	194,000	4.5	24,400
Area 2			
Surface	468,709	10.76	8,680
Subsurface	817,052	18.76	109,240
Northeast area	17,159	0.39	320
Area 2 Total	834,000	19.2	118,200
Ford Property	196,000	4.5	3,600
Totals	**1,224,000**	**28.2**	**146,000**

Note: The thickness values used to calculate volumes were as follows:

Area 1 Surface	0.5 ft
Area 1 Subsurface	3.27 ft
Area 2 Surface	0.5 ft
Area 2 Subsurface	3.61 ft
Northeast area	0.5 ft
Ford Property	0.5 ft

Table 6-13: February 2000 Analytical Results for Surface Soil Samples from the Buffer Zone and Crossroads Properties

Location	Depth (feet)	Uranium-238		Thorium-234		Uranium-234		Thorium-230		Radium-226		Lead-214		Bismuth-214		Lead-210	
		Result	MDA	Result	MDA	Result	MDA	Result	MDA	Result	MDA	Result	MDA	Result	MDA	Result	MDA
Site Specific Background(Mean+2 Std Dev)		2.24		2.76		2.73		2.45		1.30		1.13		1.61		3.77	
Surface Soil Reference Levels		7.24		7.76		7.73		7.45		6.30		6.13		6.61		8.77	
RC-01	0 - 0.25	**0.92**	*0.10*	*<MDA*	*1.48*	**1.00**	*0.15*	**2.75**	*0.09*	*<MDA*	*0.15*	**0.82**	*0.27*	**0.62**	*0.56*	**3.20**	*1.60*
RC-02	0 - 0.25	**1.08**	*0.05*	*<MDA*	*1.70*	**1.06**	*0.05*	**30.6**	*0.10*	*<MDA*	*0.13*	**1.55**	*0.25*	**1.55**	*0.70*	**5.90**	*1.30*
RC-03	0 - 0.25	**0.89**	*0.08*	*<MDA*	*1.38*	**0.80**	*0.11*	**6.30**	*0.20*	*<MDA*	*0.14*	**0.71**	*0.18*	**0.71**	*0.46*	**2.94**	*1.60*
RC-04	0 - 0.25	**0.94**	*0.05*	*<MDA*	*1.50*	**0.93**	*0.14*	**2.60**	*0.18*	*<MDA*	*0.13*	**0.56**	*0.24*	**0.87**	*0.56*	**2.70**	*1.50*
RC-05	0 - 0.25	**0.69**	*0.09*	*<MDA*	*1.63*	**0.91**	*0.16*	**2.48**	*0.08*	*<MDA*	*0.10*	**0.86**	*0.23*	**0.63**	*0.52*	**2.60**	*1.10*
RC-06	0 - 0.25	**0.96**	*0.05*	*<MDA*	*1.56*	**0.97**	*0.13*	**4.60**	*0.10*	*<MDA*	*0.12*	**0.91**	*0.24*	**0.62**	*0.57*	**3.70**	*1.50*
RC-07	0 - 0.25	**0.90**	*0.32*	*<MDA*	*1.51*	**0.63**	*0.13*	**2.84**	*0.16*	*<MDA*	*0.12*	**0.76**	*0.26*	**0.87**	*0.54*	**1.75**	*1.60*

Location	Depth (feet)	Uranium-235		Protactinium-231		Actinium-227		Radium-223	
		Result	MDA	Result	MDA	Result	MDA	Result	MDA
Site Specific Background(Mean+2 Std Dev)		NE		NE		NE		NE	
Surface Soil Reference Levels		5.00		5.00		5.00		5.00	
RC-01	0 - 0.25	*<MDA*	*0.13*	*<MDA*	*3.70*	*<MDA*	*0.63*	*<MDA*	*0.28*
RC-02	0 - 0.25	**0.14**	*0.10*	*<MDA*	*3.80*	*<MDA*	*0.80*	*<MDA*	*0.29*
RC-03	0 - 0.25	*<MDA*	*0.12*	*<MDA*	*2.60*	*<MDA*	*0.57*	*<MDA*	*0.21*
RC-04	0 - 0.25	**0.06**	*0.06*	*<MDA*	*3.40*	*<MDA*	*0.67*	*<MDA*	*0.26*
RC-05	0 - 0.25	**0.14**	*0.14*	*<MDA*	*3.10*	*<MDA*	*0.56*	*<MDA*	*0.24*
RC-06	0 - 0.25	*<MDA*	*0.18*	*<MDA*	*4.00*	*<MDA*	*0.69*	*<MDA*	*0.30*
RC-07	0 - 0.25	*<MDA*	*0.05*	*<MDA*	*3.20*	*<MDA*	*0.62*	*<MDA*	*0.22*

Location	Depth (feet)	Thorium-232		Radium-228		Thorium-228		Radium-224		Lead-212		Bismuth-212		Thallium 208	
		Result	MDA	Result	MDA	Result	MDA	Result	MDA	Result	MDA	Result	MDA	Result	MDA
Site Specific Background(Mean+2 Std Dev)		1.55		2.37		1.33		NE		2.26		NE		0.71	
Surface Soil Reference Levels		6.55		7.37		6.33		5.00		7.26		5.00		5.71	
RC-01	0 - 0.25	**1.40**	*0.07*	**1.83**	*0.71*	**1.41**	*0.09*	*<MDA*	*3.58*	0.85	*0.39*	<MDA	*2.70*	0.35	*0.26*
RC-02	0 - 0.25	**1.28**	*0.14*	**1.47**	*0.68*	**1.33**	*0.12*	*<MDA*	*2.83*	0.76	*0.38*	<MDA	*2.70*	0.31	*0.27*
RC-03	0 - 0.25	**0.97**	*0.23*	**1.67**	*0.68*	**1.36**	*0.20*	*<MDA*	*2.22*	0.94	*0.32*	<MDA	*2.00*	0.27	*0.21*
RC-04	0 - 0.25	**1.25**	*0.07*	**1.92**	*0.69*	**1.27**	*0.15*	*<MDA*	*1.88*	0.96	*0.38*	<MDA	*2.50*	0.38	*0.25*
RC-05	0 - 0.25	**1.21**	*0.09*	**1.59**	*0.66*	**1.04**	*0.08*	*<MDA*	*2.54*	1.13	*0.37*	<MDA	*2.70*	0.25	*0.23*
RC-06	0 - 0.25	**1.18**	*0.04*	**1.26**	*0.72*	**1.33**	*0.12*	*<MDA*	*2.11*	0.97	*0.40*	<MDA	*2.40*	0.30	*0.25*
RC-07	0 - 0.25	**1.56**	*0.08*	**0.96**	*0.68*	**1.44**	*0.13*	*<MDA*	*2.47*	1.05	*0.37*	<MDA	*2.50*	0.34	*0.27*

Note: The data presented on this table are based on preliminary unvalidated results.

Table 7-1 : Radon Flux Measurement Results

Area 1		Area 2	
Boring Location	Radon Flux (pCi/m^2s)	Boring Location	Radon Flux (pCi/m^2s)
WL-101	0.3	WL-201	0.5
WL-102	245.9	WL-202	0.3
WL-103	0.6	WL-203	0.4
WL-104	0.2	WL-204/205	0.3
WL-105	0.2	WL-206	0.9
WL-106	22.3	WL-207	0.5
WL-107	0.2	WL-208	3.2
WL-108	0.5	WL-209	513.1
WL-109	0.1	WL-210	14.2
WL-110	0.2	WL-211	0.1
WL-111	0.3	WL-212	0
WL-112	1.9	WL-213	0.1
WL-113	0.5	WL-214	0.2
WL-114	8	WL-215	0.3
WL-115	1.4	WL-216	0.1
WL-116	0.2	WL-217	0.2
WL-117	1.3	WL-218	1.6
WL-120	0.3	WL-219	0.3
WL-121	0.3	WL-220	0.1
WL-122	0.5	WL-221	0.8
WL-123	0.1	WL-222	1.3
WL-124	0.2	WL-223	350.2
		WL-224	0.2
		WL-225	0.3
		WL-226	0.2
		WL-227	0.5
		WL-230	0.2
		WL-231	0.2
		WL-233	0.1
		WL-234	0.6
		WL-236	0.1
		WL-239	0.4
Averages	13		28

Table 7-2 : Surface Soil Radionuclide Analytical Results at the Fugitive Dust Sampling Locations

Uranium - 238 Decay Series

Boring	Uranium-238	Thorium-234	Uranium-234	Thorium-230	Radium-226	Lead-214	Bismuth-214	Lead-210
WL-114	147+/-38	55.9+/-13.5	154+/-40	7,850+/-1,470	109+/-5	108+/-8	110+/-6	206+/-26
WL-210	134+/-42	<29.51+/-NA	216+/-67	18,190+/-3,510	2,280+/-89	1,450+/-179	2,300+/-84	1,370+/-162

Uranium - 235 Decay Series

	Uranium-235/236	Uranium-235	Protactinium-231	Actinium-227	Radium-223
WL-114	19.5+/-5.9	17.6+/-2.1	156+/-27	118+/-14	113+/-NA
WL-210	49.7+/-16.5	182+/-22	838+/-148	732+/-87	660+/-NA

Thorium - 232 Decay Series

	Thorium-232	Radium-228	Thorium-228	Radium-224	Lead-212	Bismuth-212	Thallium-208
WL-114	18.1+/-4.6	<2.50+/-NA	1.96+/-1.14	<12.42+/-NA	<1.85+/-NA	<3.9+/-NA	0.79+/-0.83
WL-210	59.2+/-23.2	<9.55+/-NA	<13.5+/-8.6	4,330+/-628	<4.7+/-NA	<17.29+/-NA	<2.34+/-NA

All values expressed as pCi/g.
< indicates that the sample result is below the Method Detection Activity (MDA), with the number indicating the MDA.
NA indicates Not Applicable or Not Available.

Table 7-3 : Fugutive Dust Analytical Results

Uranium - 238 Decay Series

Sample	Uranium-238			Uranium-234			Thorium-230			Radium-226		
	Result	MDA	+/- Sigma Error	Result	MDA	+/- Sigma Error	Result	MDA	+/- Sigma Error	Result	MDA	+/- Sigma Error
Area 1												
Upwind	< MDA	0.00164	NA	< MDA	0.00148	NA	0.00256	0.00042	0.00087	0.00043	0.00037	0.00027
Downwind	0.00071	0.00020	0.00038	0.00079	0.00024	0.00040	0.00071	0.00034	0.00033	< MDA	0.00049	NA
Area 2												
Upwind	0.00005	0.00004	0.00004	0.00007	0.00004	0.00005	0.00011	0.00006	0.00006	0.00011	0.00006	0.00005
Downwind	< MDA	0.00056	NA	< MDA	0.00049	NA	0.00055	0.00023	0.00027	< MDA	0.00035	NA

Uranium - 235 Decay Series

Sample	Uranium-235/236		
	Result	MDA	+/- Sigma Error
Area 1			
Upwind	< MDA	0.00237	NA
Downwind	< MDA	0.00030	NA
Area 2			
Upwind	< MDA	0.00007	NA
Downwind	< MDA	0.00068	NA

Thorium - 232 Decay Series

Sample	Thorium-232			Radium-228			Thorium-228		
	Result	MDA	+/- Sigma Error	Result	MDA	+/- Sigma Error	Result	MDA	+/- Sigma Error
Area 1									
Upwind	< MDA	0.00027	NA	< MDA	0.00113	NA	0.00270	0.00044	0.00090
Downwind	< MDA	0.00024	NA	< MDA	0.00097	NA	0.00191	0.00017	0.00058
Area 2									
Upwind	< MDA	0.00004:	NA	< MDA	0.00017	NA	0.00037	0.00007	0.00013
Downwind	< MDA	0.00026	NA	0.00091	0.00090	0.00056	0.00154	0.00029	0.00049

All values expressed as picocuries per liter (pCi/L)
MDA = Minimum Detectable Activity
NA= Not applicable

Table 7-4 : Comparison of 1995, 1996, and 1997 Radium-226 Results in Groundwater Samples

Well	Date	Filtered	Radium-226
S-82	Nov-95	Filtered	--
S-82	Nov-95	unfiltered	--
S-82	Feb-96	Filtered	--
S-82	Feb-96	unfiltered	1.09+/-
S-82	May-96	Filtered	0.88+/-
S-82	May-96	unfiltered	1.39+/-
S-82	May-97	Filtered	1.07+/-0.14
S-82	May-97	unfiltered	1.06+/-0.17
S-82	May-97	unfiltered	0.76+/-0.14
I-2	Nov-95	Filtered	--
I-2	Nov-95	unfiltered	--
I-2	Feb-96	Filtered	--
I-2	Feb-96	unfiltered	1.69+/-
I-2	May-96	Filtered	1.17+/-
I-2	May-96	unfiltered	1.44+/-
I-2	May-97	Filtered	0.98+/-0.13
I-2	May-97	unfiltered	1.05+/-0.13
I-2-DUP	May-97	Filtered	0.82+/-0.11
I-2-DUP	May-97	unfiltered	1.09+/-0.14
I-4	Feb-96	Filtered	--
I-4	Feb-96	unfiltered	2.41+/-
I-4	May-96	Filtered	0.87+/-
I-4	May-96	unfiltered	1.5+/-
I-4	May-97	Filtered	0.81+/-0.11
I-4	May-97	unfiltered	1.04+/-0.14
D-3	Nov-95	Filtered	--
D-3	Nov-95	unfiltered	--
D-3	Feb-96	Filtered	--
D-3	Feb-96	unfiltered	2.7+/-
D-3	May-96	Filtered	0.78+/-
D-3	May-96	unfiltered	1.19+/-
D-3 DUP (F)	May-96	Filtered	1.17+/-
D-3 DUP (F)	May-96	unfiltered	1.21+/-
D-3	May-97	Filtered	0.75+/-0.11
D-3	May-97	unfiltered	1.5+/-0.19

Table 7-4 : Comparison of 1995, 1996, and 1997 Radium-226 Results in Groundwater Samples (cont.)

Well	Date	Filtered	Radium-226
D-6	Nov-95	Filtered	--
D-6	Nov-95	unfiltered	--
D-6	Feb-96	Filtered	--
D-6	Feb-96	unfiltered	1.78+/-
D-6	May-96	Filtered	1.66+/-
D-6	May-96	unfiltered	1.88+/-
D-6	May-97	Filtered	1.8+/-0.21
D-6	May-97	unfiltered	2.05+/-0.23
D-12	Nov-95	Filtered	--
D-12	Nov-95	unfiltered	--
D-12	Feb-96	Filtered	--
D-12	Feb-96	unfiltered	0.5+/-
D-12	May-96	Filtered	0.36+/-
D-12	May-96	unfiltered	0.73+/-
D-12	May-97	Filtered	0.49+/-0.12
D-12	May-97	Filtered	0.26+/-0.09
D-12	May-97	unfiltered	0.54+/-0.09
D-93	Nov-95	Filtered	--
D-93	Nov-95	unfiltered	--
D-93	Feb-96	Filtered	--
D-93	Feb-96	unfiltered	1.43+/-
D-93 DUP (F)	Feb-96	Filtered	--
D-93 DUP (F)	Feb-96	unfiltered	1.21+/-
D-93	May-96	Filtered	0.95+/-
D-93	May-96	unfiltered	2.09+/-
D-93	May-97	Filtered	1.18+/-0.15
D-93	May-97	unfiltered	1.34+/-0.16

Notes:

All units are pCi/l
- indicates not analyzed
1997 values are highlighted (bold)
< indicates sample results is below the specific minimum detectable activity (MDA

Table 8-1: Priority Pollutant Metals Summary for Soil Samples

Area 1 Soil Samples

Constituent	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value	Background Range
Arsenic	13	10	0.77	0.76	220	WL 114 @0'	<0.5-5.2
Beryllium	13	8	0.62	0.25	3.3	WL 114 @0'	<0.25-.5
Cadmium	13	2	0.15	4.2	7.9	WL 114 @0'	<0.5
Chromium	13	13	1	3.1	280	WL 115 @5'	8.6-12
Copper	13	13	1	2.3	2300	WL 114 @0'	11-16
Lead	13	13	1	2.8	900	WL 115 @5'	7.5-32
Mercury	13	1	0.08	0.17	0.17	WL 114 @0'	<0.1
Nickel	13	13	1	4.7	3600	WL 114 @0'	3.6-16
Selenium	13	4	0.31	0.36	250	WL 114 @0'	<0.25
Zinc	13	13	1	16	560	WL 115 @38' WL-119 @50' (dup)	2.1-48

Area 2 Soil Samples

Constituent	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value	Background Range
Arsenic	24	23	0.96	0.7	35	WL-209@0'	<0.5-5.2
Beryllium	24	12	0.50	0.27	2.2	WL-206@0'	<0.25-.5
Cadmium	24	9	0.38	0.54	6.3	WL-208@20'	<0.5
Chromium	24	24	1.00	2	890	WL-206@0'	8.6-12
Copper	24	24	1.00	1	360	WL-209@0'	11-16
Lead	24	23	0.96	3	2200	WL-210@0'	7.5-32
Mercury	24	3	0.13	0.18	0.27	WL-209@0'	<0.1
Nickel	24	24	1.00	1.3	680	WL-209@0'	3.6-16
Selenium	24	6	0.25	0.25	38	WL-210@0'	<0.25
Zinc	24	23	0.96	7.3	1100	WL-208@20'	2.1-48

Note: All units are mg/kg (ppm)

Table 8-2: Total Petroleum Hydrocarbons Summary for Soil Samples

Area 1 Soil Samples

Constituent	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value
Gasoline Range	17	1	0.06	120	120	WL-115 @5'
Diesel Range	17	1	0.06	110	110	WL-101 @5'
Motor Oil Range	17	3	0.18	76	130	WL-114 @0'

Area 2 Soil Samples

Constituent	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value
Gasoline Range	24	4	0.17	24	5000	WL-208 @20'
Diesel Range	24	3	0.13	31	1200	WL-210 @15'
Motor Oil Range	24	11	0.46	11	16000	WL-208 @20'

Note: All units are mg/kg (ppm)

Table 8-3: Volatile Organic Compounds Summary for Soil Samples

Area 1 Soil Samples

Constituent	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value
Toluene	19	3	0.16	0.008	29	WL -115 @5'
Ethyl benzene	19	3	0.16	0.005	20	WL -115 @5'
m & p Xylene	19	5	0.26	0.002	200	WL -115 @5'
o-Xylene	19	3	0.16	0.0027	26	WL -115 @5'
Chlorobenzene	19	6	0.32	0.002	0.94	WL-104 @25'
1,4-Dichlorobenzene	19	7	0.37	0.002	0.042	WL-114 @0'
2-Butanone	15	2	0.13	0.013	0.02	WL-106 @30' (dup)
Acetone	15	7	0.47	0.019	0.09	WL-106 @30' (dup)
Methylene Chloride	19	0	0	0	0	None Detected

Area 2 Soil Samples

Constituent	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value
Toluene	24	4	0.17	0.13	8300	WL-208 @20'
Ethyl benzene	24	8	0.33	0.004	300	WL-208 @20'
m & p Xylene	24	9	0.38	0.012	1800	WL-208 @20'
o-Xylene	24	6	0.25	0.007	500	WL-208 @20'
Chlorobenzene	24	5	0.21	0.003	180	WL-230 @16'
1,4-Dichlorobenzene	24	6	0.25	0.0065	2100	WL-230 @16'
2-Butanone	24	2	0.08	8.4	52	WL-208 @15'
Acetone	24	5	0.21	0.026	62	WL-230 @35'
Methylene Chloride	24	8	0.33	0.004	240	WL-208 @20'

Note: All units are mg/kg (ppm)

Table 8-4: Semi-Volatile Organic Compounds Summary for Soil Samples

Area 1 Soil Samples

Constituent	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value
Benzoic Acid	15	0	0	0	0	No Detects
1,4-Dichlorobenzene	17	1	0.06	0.039	0.039	WL-113 @45'
Pyrene	17	3	0.18	0.034	0.7	WL-115 @5'
Naphthalene	17	2	0.12	0.13	4.7	WL-115 @5'
2-Methylnaphthalene	15	2	0.13	0.097	4.4	WL-115 @5'
Fluoranthene	17	3	0.18	0.035	0.73	WL-115 @5'
Phenanthrene	17	2	0.12	0.044	0.91	WL-115 @5'
Phenol	17	0	0.00	0	0	No Detects
4-Methylphenol	15	0	0.00	0	0	No Detects
Butyl benzyl phthalate	17	5	0.29	0.069	180	WL-115 @5'
Diethylphalate	17	1	0.06	0.033	0.033	WL-114 @0'
Di-n-butylphthalate	17	2	0.12	0.3	10	WL-113 @45'
Di-n-octylphthalate	17	4	0.24	0.17	3.7	WL-115 @5'
Bis(2-Ethylhexyl)phthalate	17	10	0.59	0.12	25	WL-113 @45'

Note: All units are mg/kg (ppm)

Table 8-4: Semi-Volatile Organic Compounds Summary for Soil Samples (cont.)

Area 2 Soil Samples

Constituent	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value
Benzoic Acid	24	3	0.13	0.15	0.79	WL-235 @0'
1,4-Dichlorobenzene	24	3	0.13	0.062	530	WL-230 @16'
Pyrene	24	0	0.00	0	0	No Detects
Naphthalene	24	8	0.33	0.034	10	WL-218@25'
2-Methylnaphthalene	24	2	0.08	0.19	2.9	WL-210 @15'
Fluoranthene	24	1	0.04	0.92	0.92	WL-218 @0'
Phenanthrene	24	1	0.04	0.073	0.073	WL-208 @15'
Phenol	24	4	0.17	0.41	9	WL-210 @15'
4-Methylphenol	24	4	0.17	0.078	9.8	WL-213 @25'
Butyl benzyl phthalate	24	2	0.08	0.52	5100	WL-208 @20'
Diethylphalate	24	2	0.08	0.053	0.082	WL-208 @15'
Di-n-butylphthalate	24	1	0.04	0.2	0.2	WL-208 @15'
Di-n-octylphthalate	24	2	0.08	0.15	12	WL-215 @25'
Bis(2-Ethylhexyl)phthalate	24	18	0.75	0.11	180	WL-208 @20'

Note: All units are mg/kg (ppm)

Table 8-5: Pesticides and Polychlorinated Biphenyls Summary for Soil Samples

Area 1 Soil Samples

Constituent	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value
4,4'-DDD	18	3	0.17	0.00079	0.015	WL-115@5'
4,4'-DDE	18	2	0.11	0.00072	0.00088	WL-113@45'
4,4'-DDT	18	3	0.17	0.0018	0.063	WL-115@5'
Aldrin	18	2	0.11	0.0011	0.16	WL-115@5'
beta-BHC	18	1	0.06	0.017	0.017	WL-115@5'
Dieldrin	18	5	0.28	0.00092	0.042	WL-115@5'
Endosulfan I	18	1	0.06	0.0011	0.0011	WL-101@5'
Endrin	18	2	0.11	0.0039	0.0093	WL-115@5'
Aroclor 1242	18	2	0.11	0.033	2.6	WL-115@5'
Aroclor 1248	18	0	0.00	0	0	No Detects
Aroclor 1254	18	1	0.06	1.1	1.1	WL-115@5'

Note: All units are mg/kg (ppm)

Table 8-5: Pesticides and Polychlorinated Biphenyls Summary for Soil Samples (cont.)

Area 2 Soil Samples

Constituent	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value
4,4'-DDD	20	2	0.10	0.00078	0.0076	WL-235@0'
4,4'-DDE	20	2	0.10	0.0021	0.0078	WL-214@25'
4,4'-DDT	20	6	0.30	0.00087	0.018	WL-230@16'
Aldrin	20	9	0.45	0.00044	0.47	WL-218@25'
beta-BHC	20	2	0.10	0.0044	0.028	WL-218@25'
Dieldrin	20	1	0.05	0.0012	0.0012	WL-230@35'
Endosulfan I	20	1	0.05	0.011	0.011	WL-214@25'
Endrin	20	2	0.10	0.0027	0.18	WL-218@25'
Aroclor 1242	24	3	0.13	0.067	1	WL-230@16'
Aroclor 1248	24	3	0.13	0.017	18	WL-218@25'
Aroclor 1254	24	3	0.13	0.18	1.6	WL-209@0' WL-210@0'

Note: All units are mg/kg (ppm)

Table 8-6: Priority Pollutant Metals Summary for Groundwater Samples

Constituent	Sampling Date	Type of Sample	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value
Arsenic	November 1995	Unfiltered	33	14	0.42424	18	420	MW-F3
		Filtered	33	13	0.39394	11	400	MW-F3
	February 1996	Filtered	33	12	0.36364	10	260	MW-F3
Chromium	November 1995	Unfiltered	33	9	0.27273	10	62	S-80
		Filtered	33	1	0.0303	11	11	S-10
	February 1996	Filtered	33	2	0.06061	15	22	S-5
Copper	November 1995	Unfiltered	33	6	0.18182	23	76	S-80
		Filtered	33	0	0	0	0	No Detects
	February 1996	Filtered	33	0	0	0	0	No Detects
Lead	November 1995	Unfiltered	33	23	0.69697	3.1	70	MW-F3
		Filtered	33	1	0.0303	4.1	4.1	I-4
	February 1996	Filtered	33	1	0.0303	7.9	7.9	S-5
Nickel	November 1995	Unfiltered	33	9	0.27273	23	93	S-5
		Filtered	33	5	0.15152	21	99	S-5
	February 1996	Filtered	33	4	0.12121	20	110	S-5
Zinc	November 1995	Unfiltered	33	19	0.57576	22	330	D-14
		Filtered	33	3	0.09091	28	77	D-83
	February 1996	Filtered	33	4	0.12121	20	49	I-11

Note: All units are ug/L (ppb)

Table 8-7: Total Petroleum Hydrocarbons Summary for Groundwater Samples

Constituent	Sampling Date	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value
Diesel Range	November 1995	33	3	0.09	0.59	3.5	S-5
	February 1996	33	1	0.03	0.53	0.53	D-14
Motor Oil Range	November 1995	33	3	0.09	0.65	2.3	I-11
	February 1996	33	0	0	0	0	Not Detected

Note: All units are mg/L (ppm)

Table 8-8: Volatile Organic Compounds Summary for Groundwater Samples

Constituent	Sampling Date	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value
Benzene	November 1995	33	2	0.06	9.3	11	I-2
	February 1996	33	4	0.12	5.6	7.4	I-9
Chlorobenzene	November 1995	33	5	0.15	5.3	170	D-14
	February 1996	33	4	0.12	9.6	150	D-14
1,4-Dichlorobenzene	November 1995	33	3	0.09	12	50	D-14
	February 1996	33	3	0.09	9.9	46	D-14
cis-1,2-Dichloroethene	November 1995	33	3	0.09	7.2	26	S-82
	February 1996	33	3	0.09	8.6	34	S-82
Acetone	November 1995	33	3	0.09	37	68	D-12
	February 1996	33	0	0	0	0	No Detects

Note: All units are ug/L (ppb)

Table 8-9: Semi-Volatile Organic Compounds Summary for Groundwater Samples

Constituent	Sampling Date	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value
1,4-Dichlorobenzene	November 1995	33	2	0.06	12	18	D-14
	February 1996	33	1	0.03	38	38	D-14
4-Methylphenol	November 1995	33	2	0.06	67	290	I-11
	February 1996	33	0	0.00			Not Detected
Di-n-octylphthalate	November 1995	33	1	0.03	13	13	I-62
	February 1996	33	0	0.00			Not Detected
Bis(2-Ethylhexyl)phthalate	November 1995	33		0.00			Not Detected
	February 1996	33	0	0.00			Not Detected

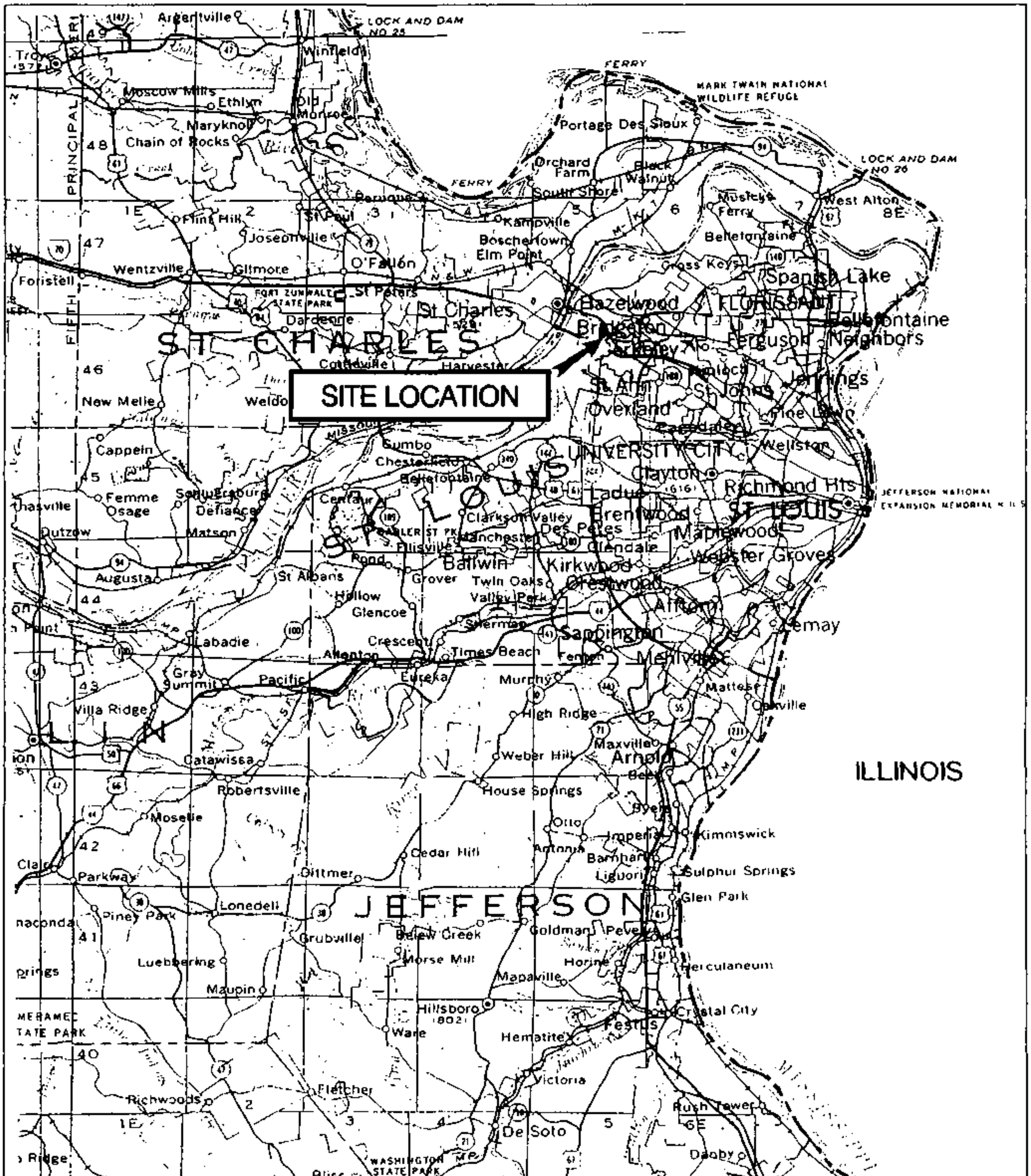
Note: All units are ug/L (ppb)

Table 8-10: Pesticides and Polychlorinted Biphenyls Summary for Groundwater Samples

Constituent	Sampling Date	Number Samples	Number of Detections	Frequency Detection	Minimum Detection Value	Maximum Detection Value	Sample Exhibiting the Maximum Value
4,4'-DDD	November 1995	33	1	0.03	0.11	0.11	S-5
	February 1996	33	0	0.00			Not Detected
Aldrin	November 1995	33	1	0.03	0.02	0.02	D-6
	February 1996	33	0	0.00			Not Detected
gamma-BHC (Lindane)	November 1995	33	1	0.03	0.011	0.011	D-85
	February 1996	33	0	0.00			Not Detected

Note: All units are ug/L (ppb)

Figures



8 0 8

SCALE IN MILES

N

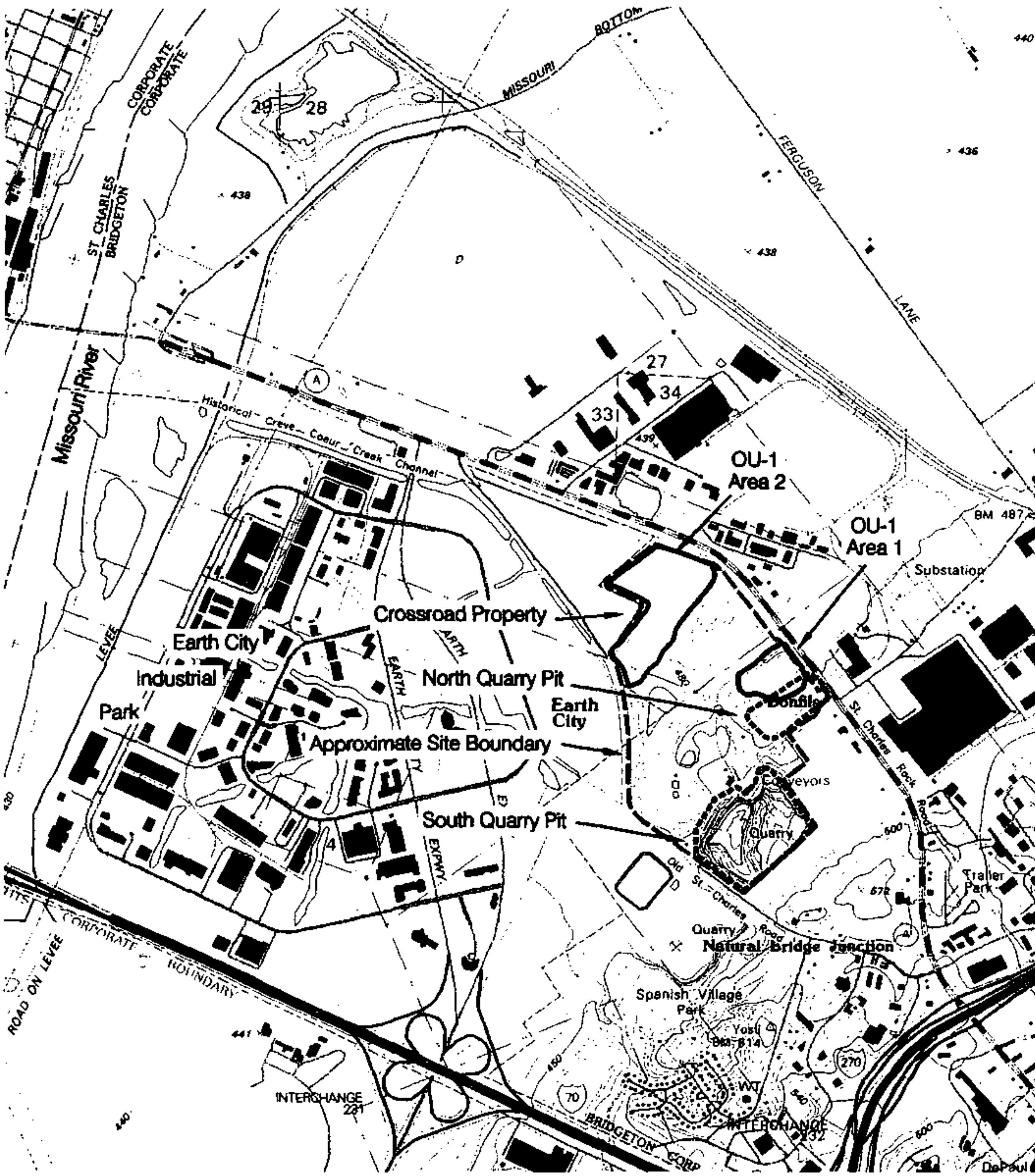
Figure 3-1

Site Vicinity Map

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

4/10/00 FR fig-3-1.dwg



Source: St. Charles, MO USGS
7.5' Quadrangle, 1994

(modified from Golder Associates, 1996, Figure 1-2)

2000 0 2000

SCALE IN FEET

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Figure 3-2

Site Location Map

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/13/00 R fig-3-2.dwg

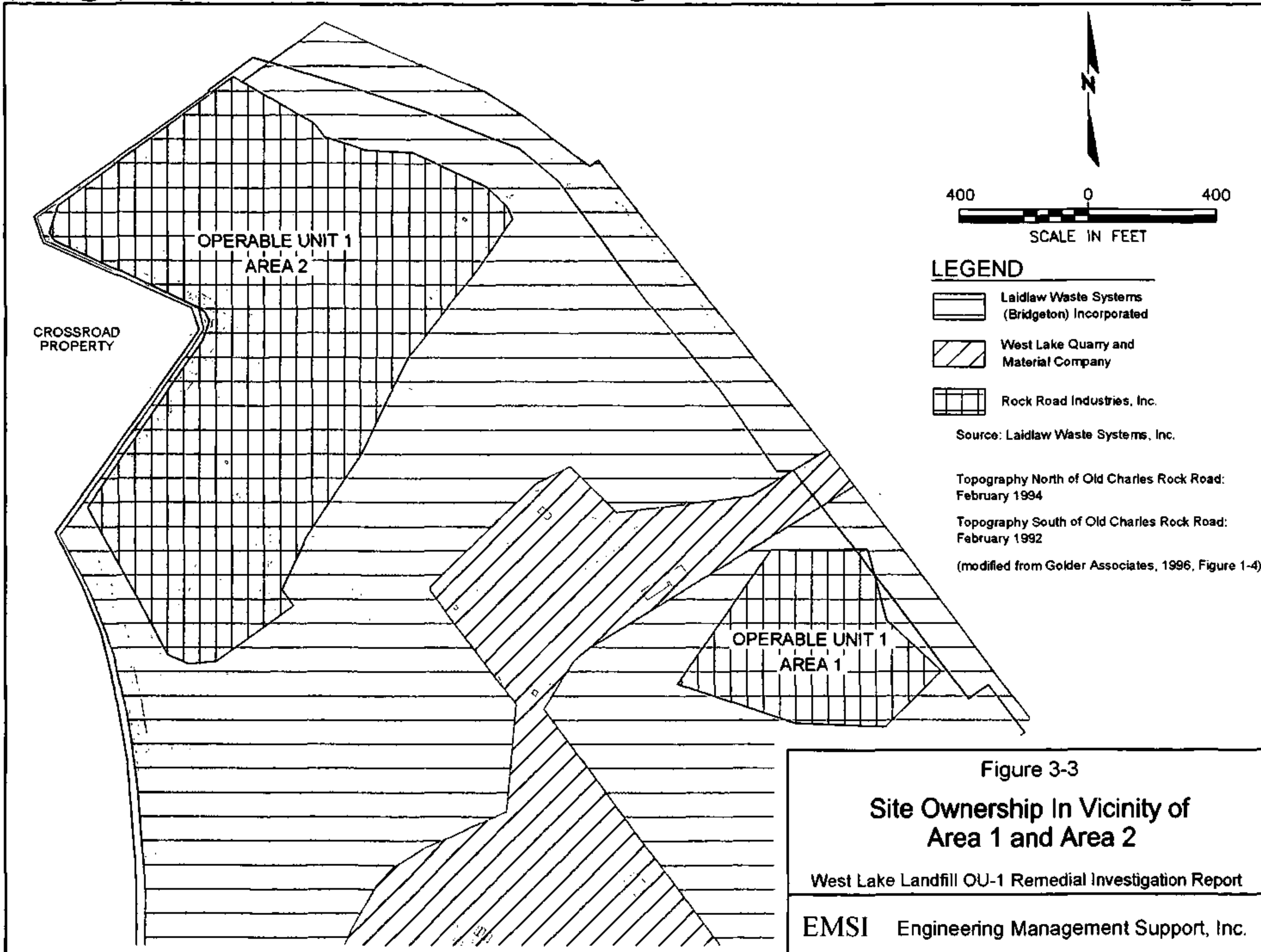
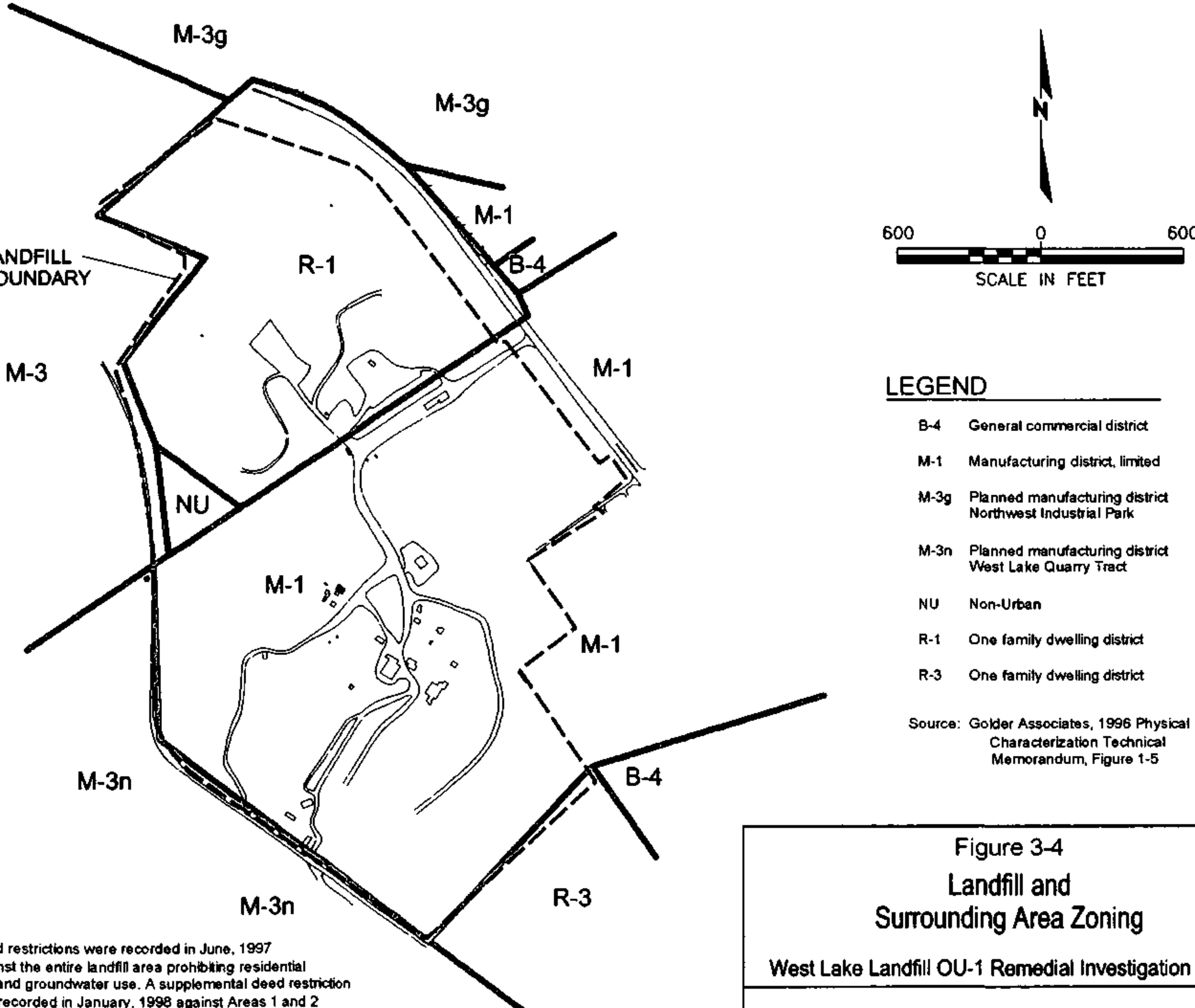


Figure 3-3

Site Ownership In Vicinity of Area 1 and Area 2

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.



LEGEND

B-4	General commercial district
M-1	Manufacturing district, limited
M-3g	Planned manufacturing district Northwest Industrial Park
M-3n	Planned manufacturing district West Lake Quarry Tract
NU	Non-Urban
R-1	One family dwelling district
R-3	One family dwelling district

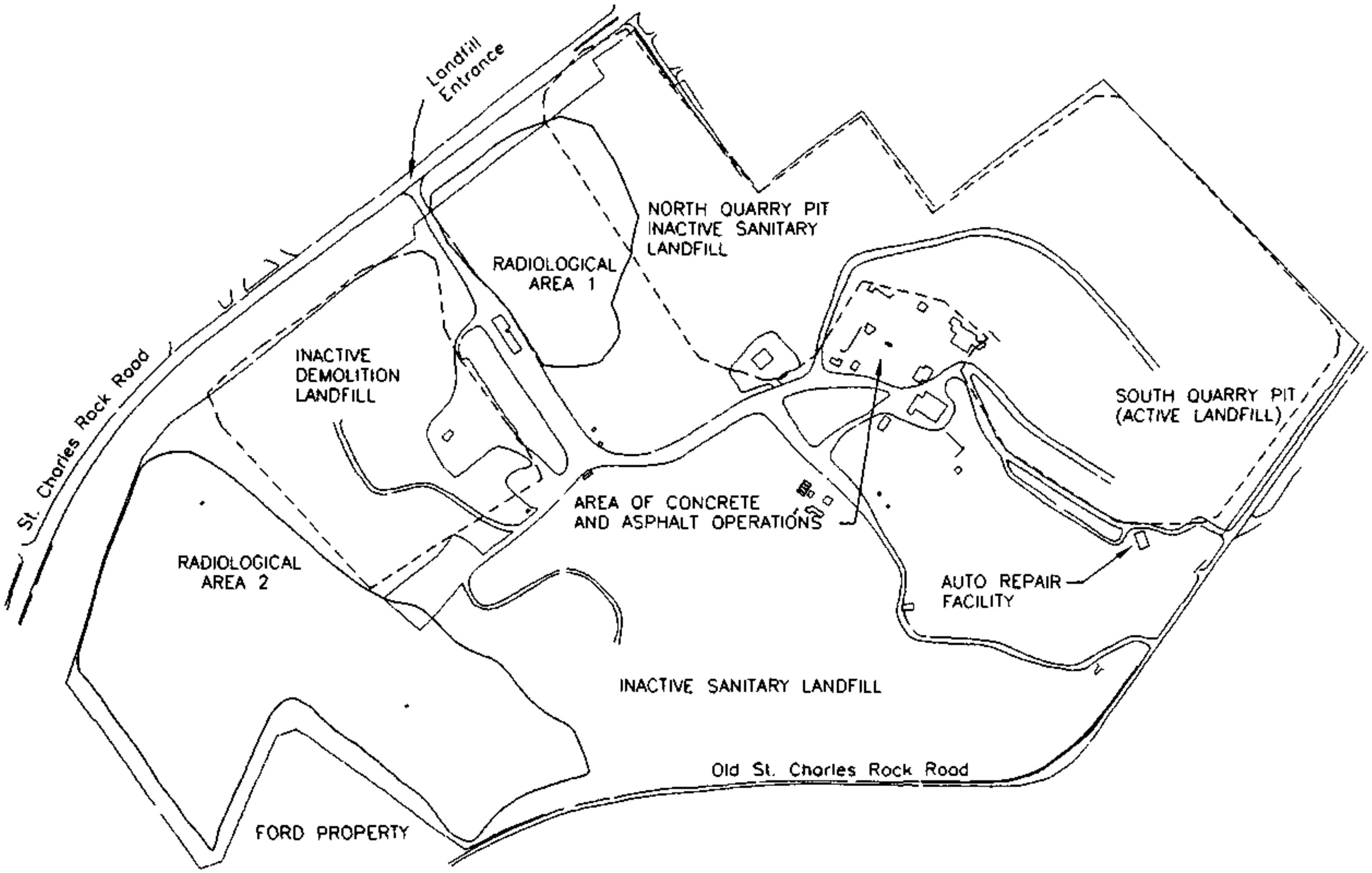
Source: Golder Associates, 1996 Physical Characterization Technical Memorandum, Figure 1-5

Note: Deed restrictions were recorded in June, 1997 against the entire landfill area prohibiting residential use and groundwater use. A supplemental deed restriction was recorded in January, 1998 against Areas 1 and 2 prohibiting the placement of buildings and restricting the installation of underground utilities, pipes, and/or excavation.

Figure 3-4
Landfill and Surrounding Area Zoning

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.



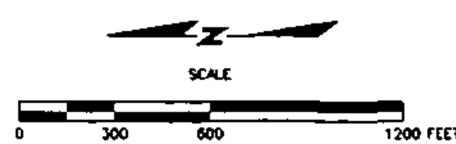


Figure 3-5

Areas of Landfill Operations

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

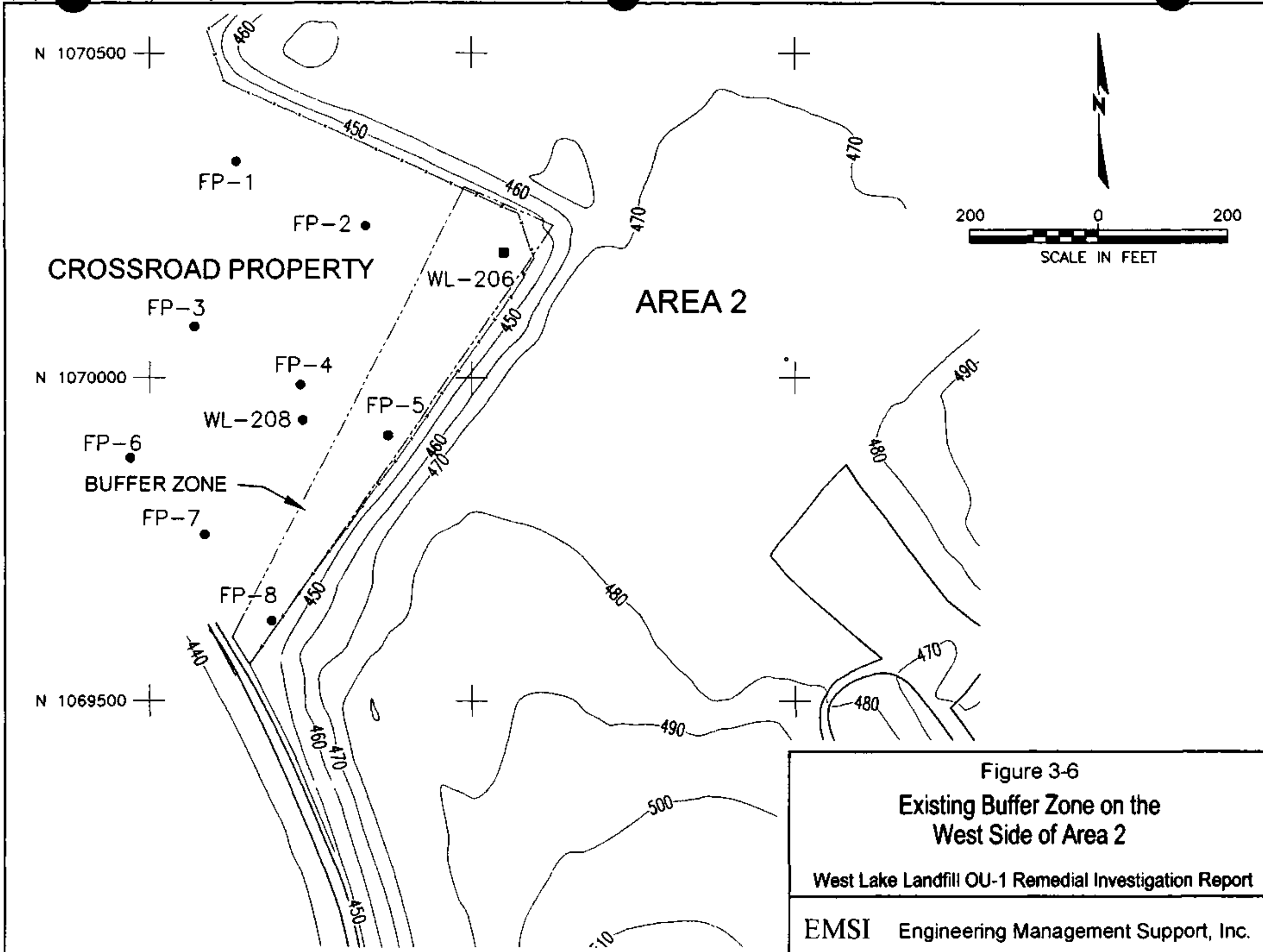


Figure 3-6
Existing Buffer Zone on the West Side of Area 2

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

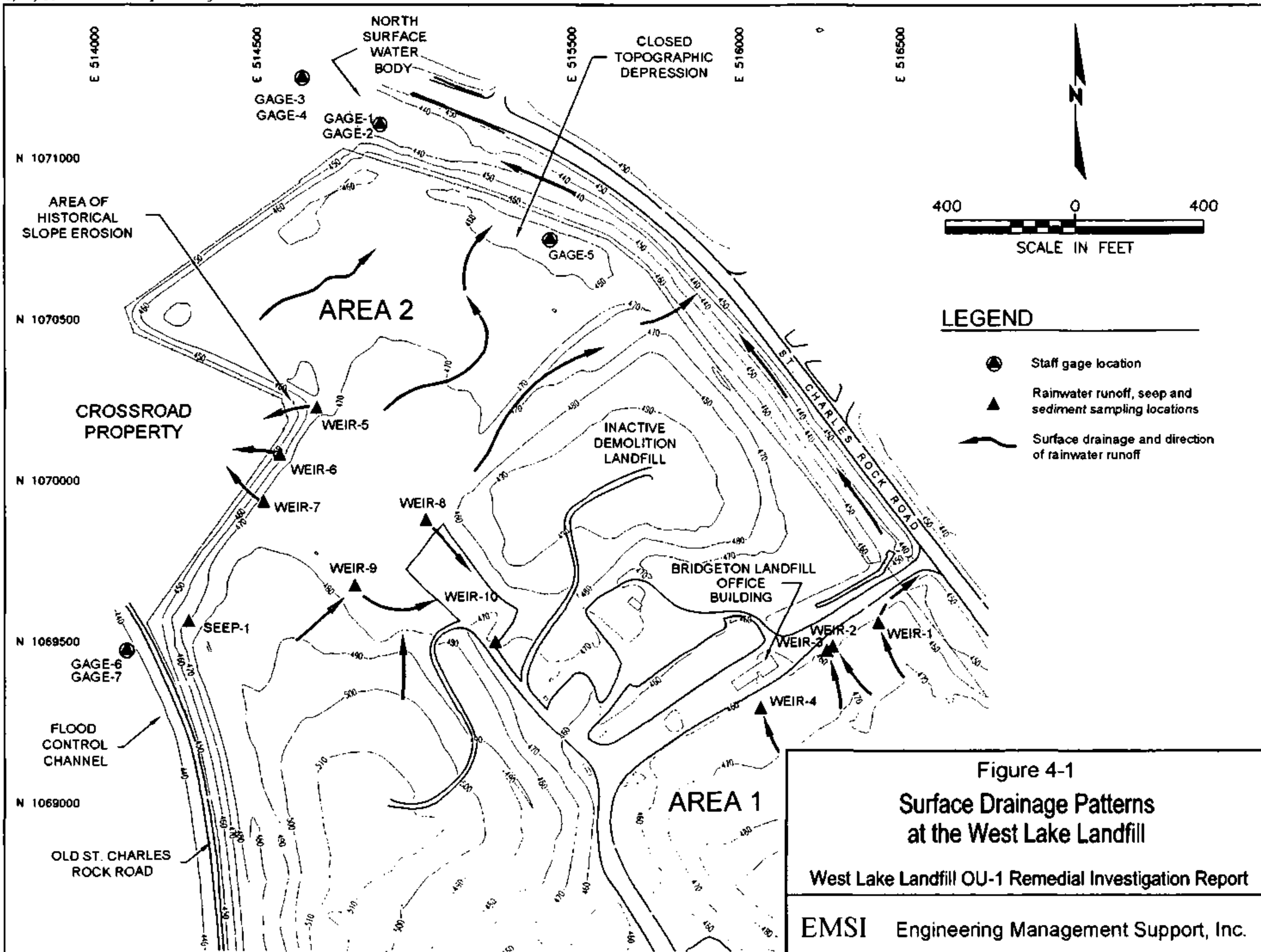


Figure 4-1
Surface Drainage Patterns at the West Lake Landfill
West Lake Landfill OU-1 Remedial Investigation Report
EMSI Engineering Management Support, Inc.

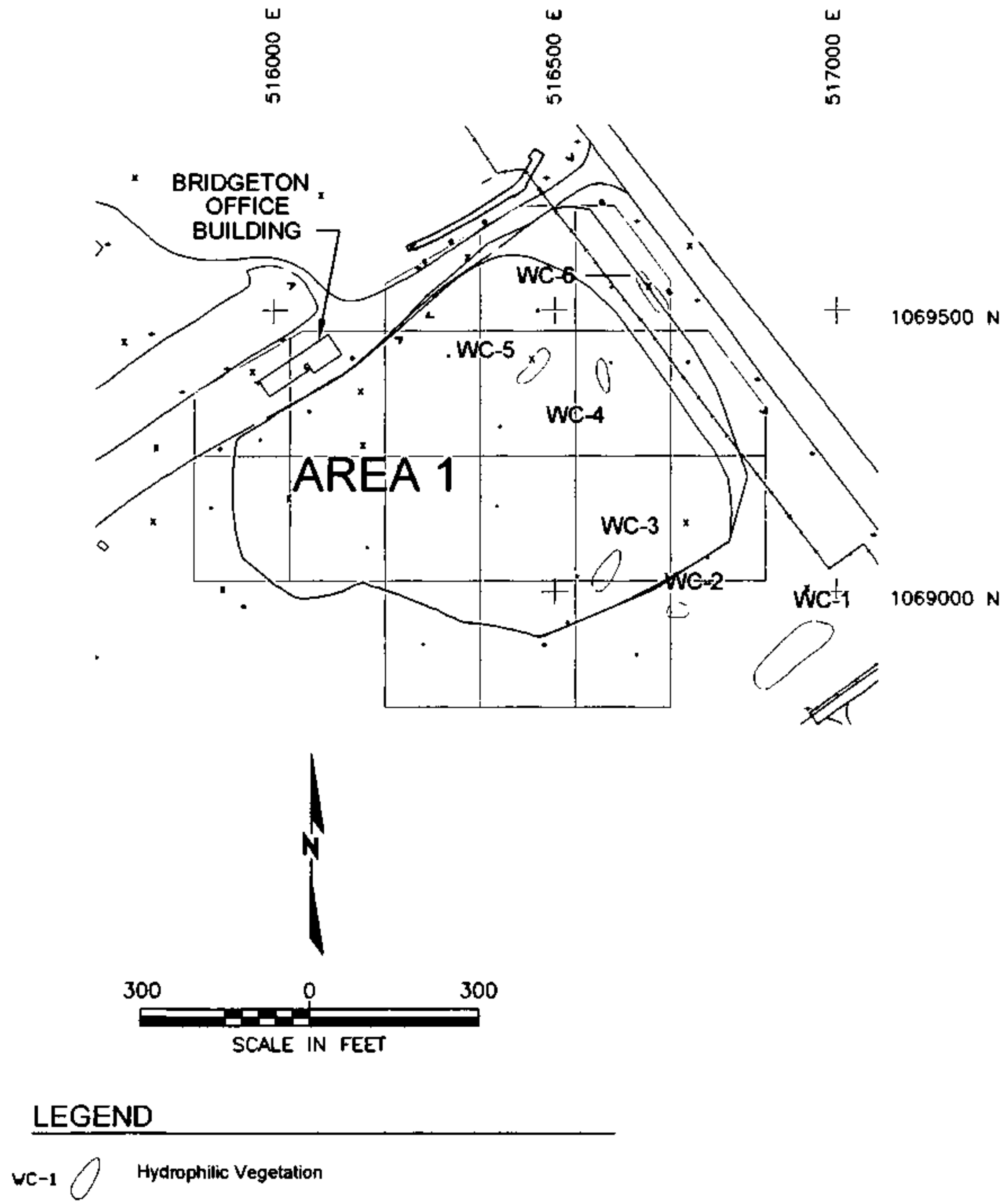


Figure 4-2
Areas of Hydrophilic Vegetation in Area 1

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/16/00 FR fig-4-2.dwg

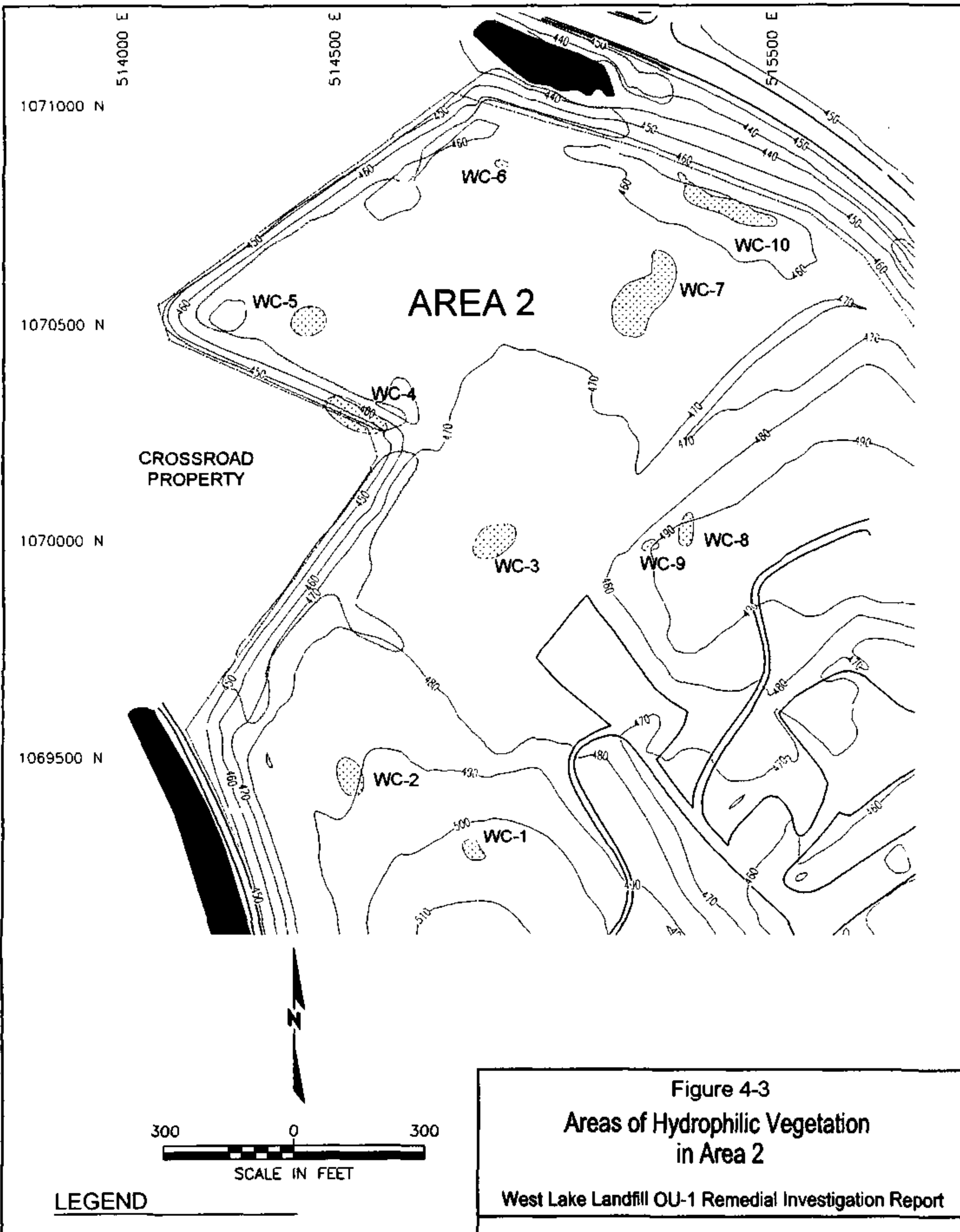


Figure 4-3
Areas of Hydrophilic Vegetation in Area 2

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/16/00 FR fig-4-3.dwg

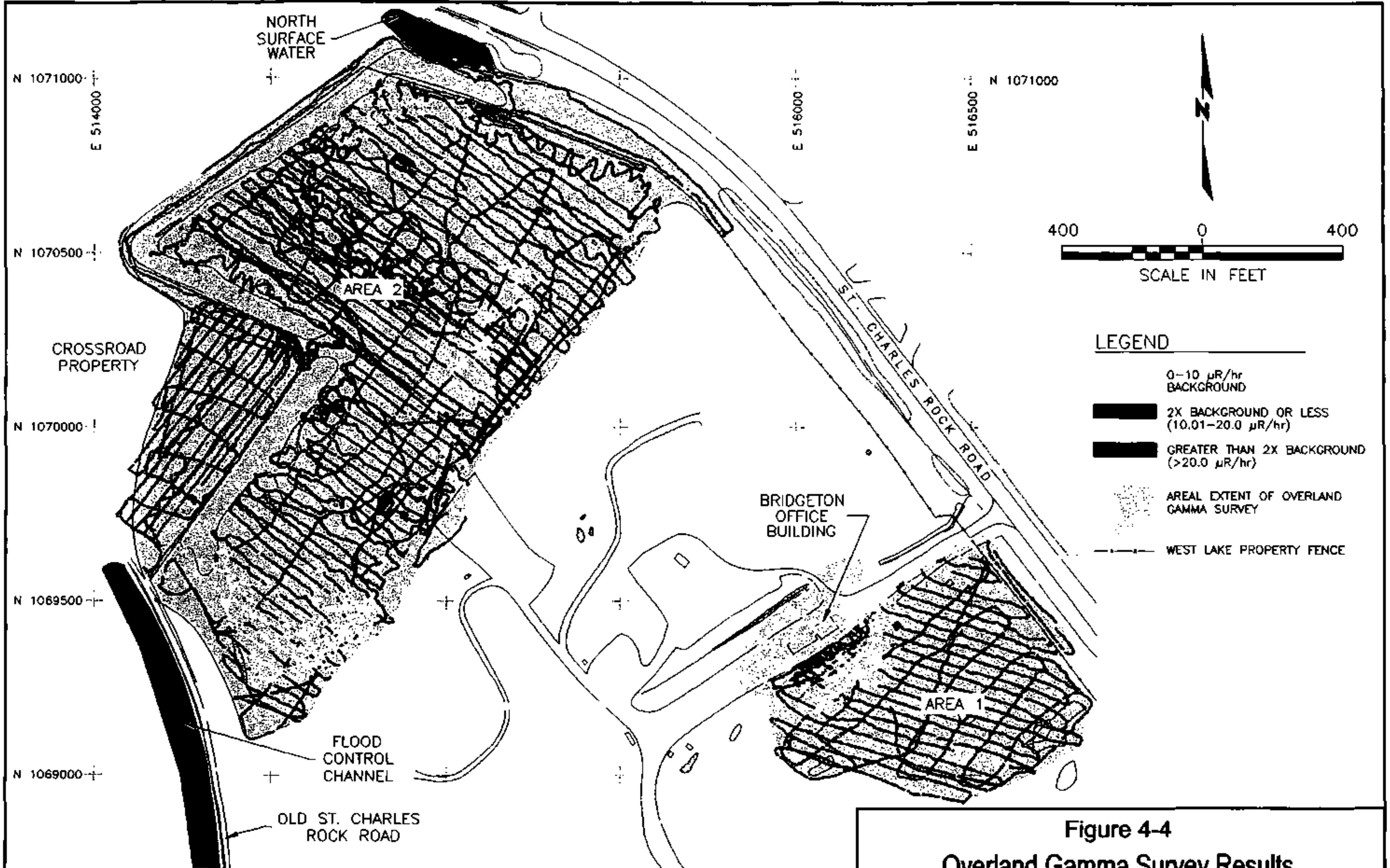


Figure 4-4

Overland Gamma Survey Results Compared to a 10 μR/hr Background Value

West Lake Landfill OU-1 Remedial Investigation Report

EMSI **Engineering Management Support, Inc.**

3/15/00 FR fig-4-5.dwg

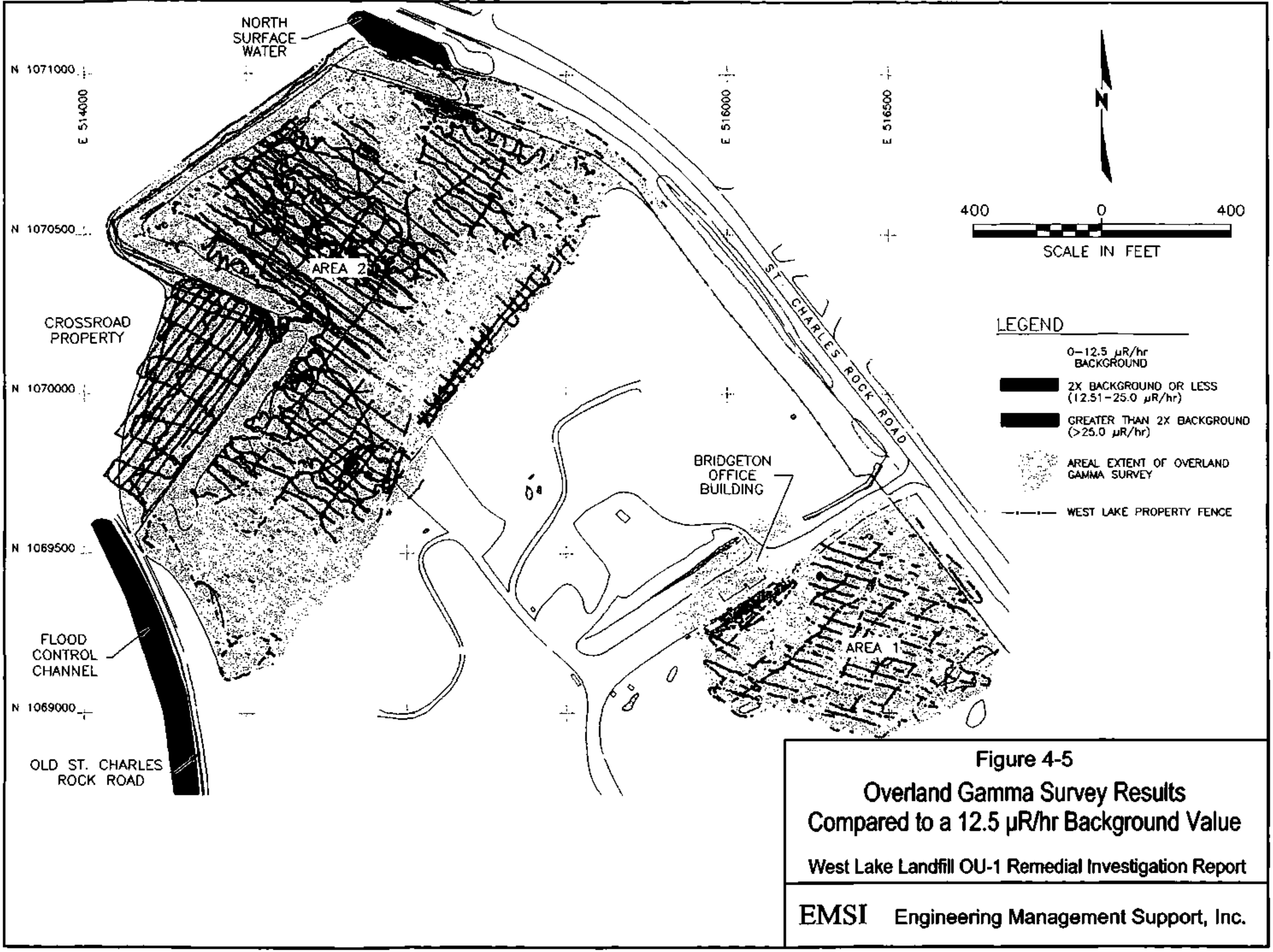


Figure 4-5

Overland Gamma Survey Results Compared to a 12.5 μR/hr Background Value

West Lake Landfill OU-1 Remedial Investigation Report

EMSI **Engineering Management Support, Inc.**

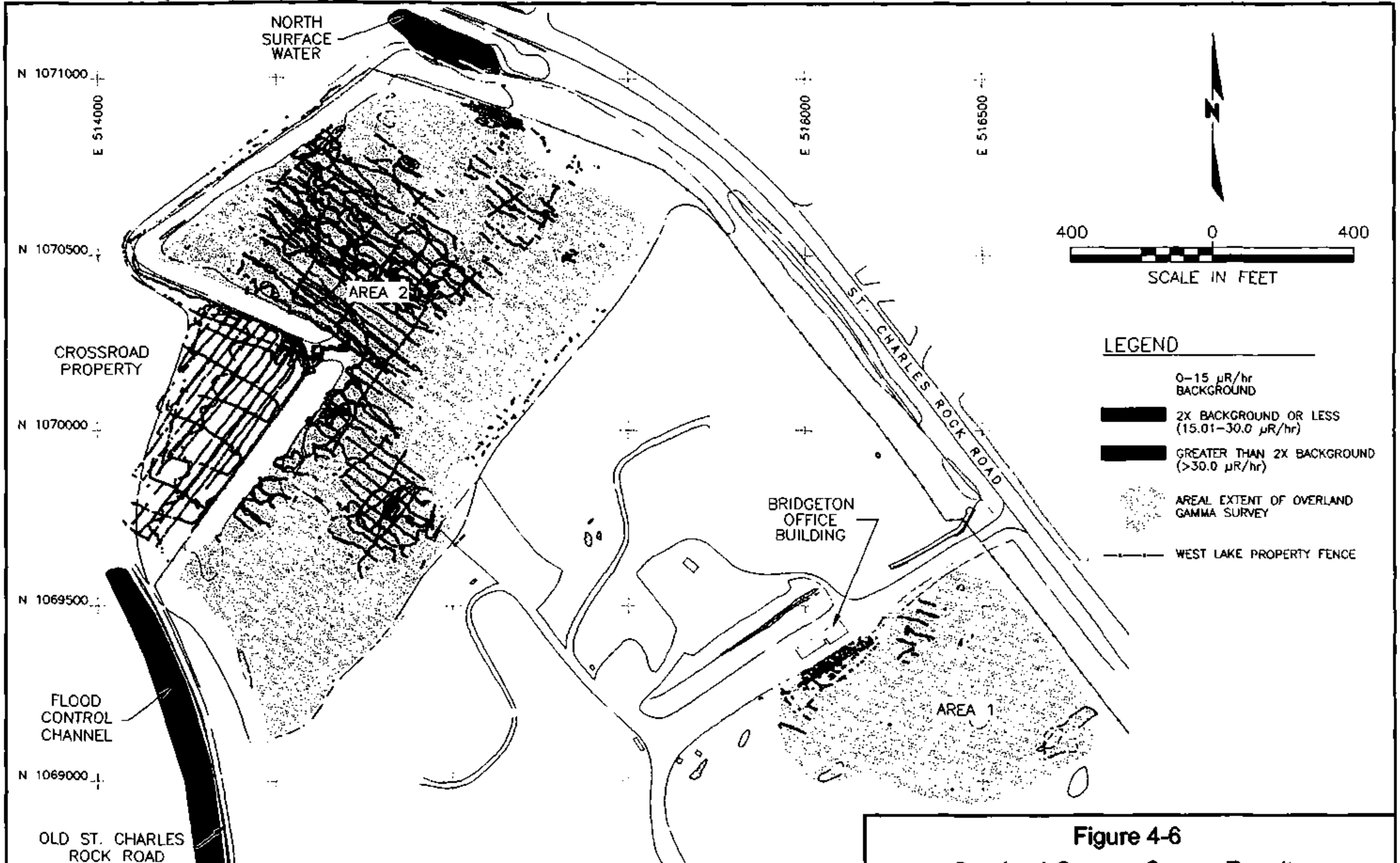


Figure 4-6

Overland Gamma Survey Results Compared to a 15 µR/hr Background Value

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/15/00 FR fig-4-7.dwg

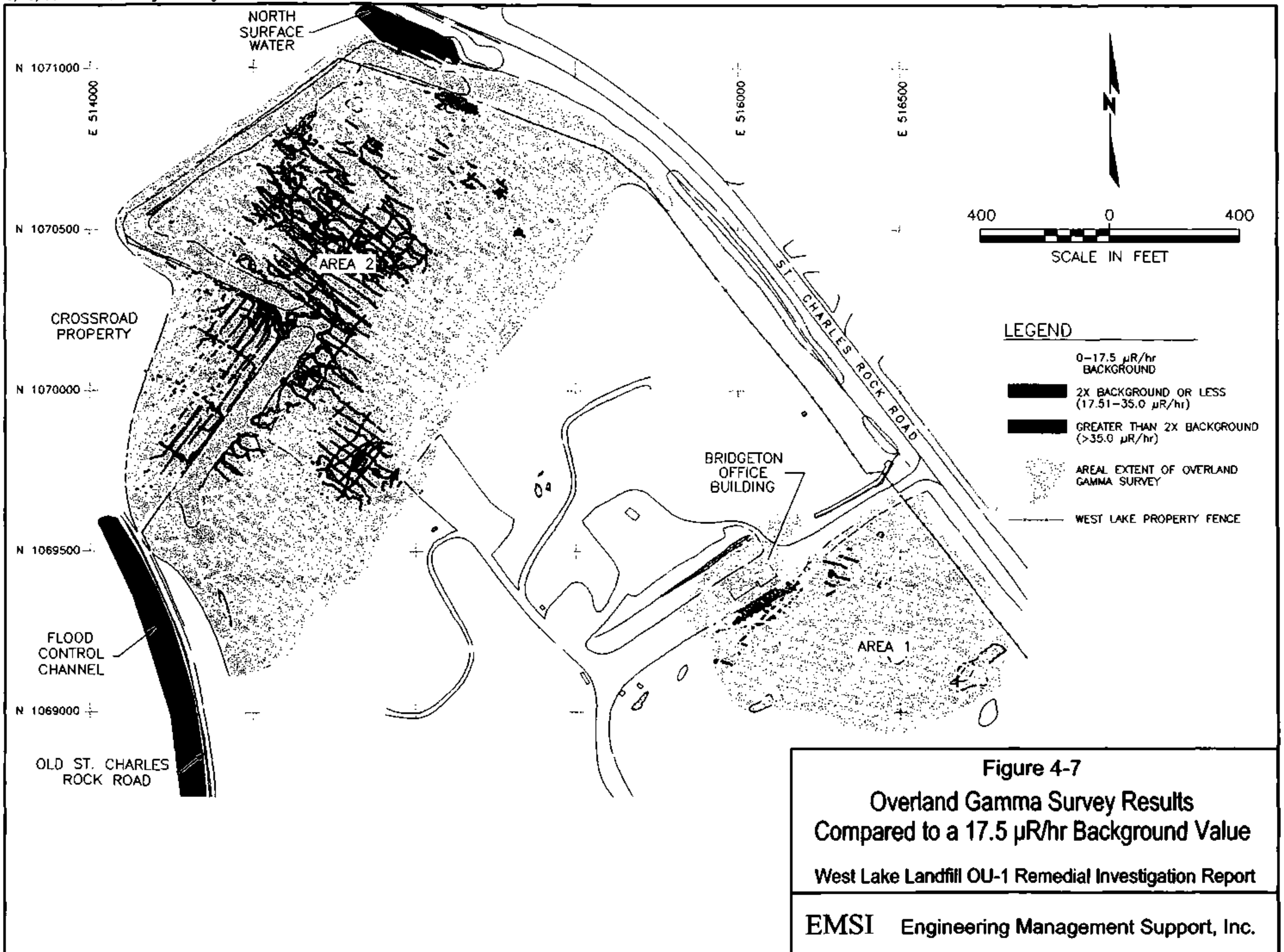


Figure 4-7
Overland Gamma Survey Results Compared to a 17.5 μR/hr Background Value

West Lake Landfill OU-1 Remedial Investigation Report

EMSI **Engineering Management Support, Inc.**

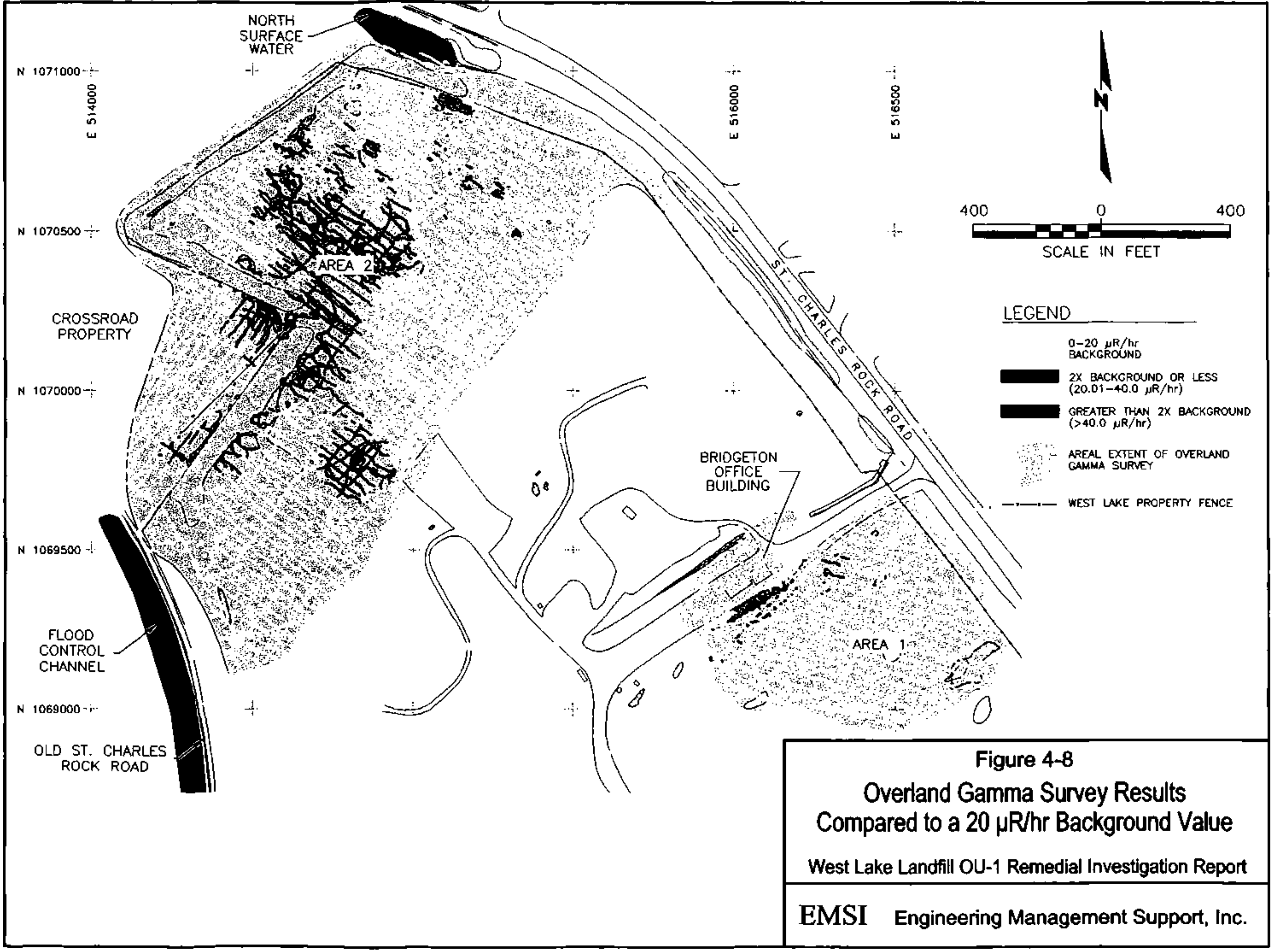


Figure 4-8
Overland Gamma Survey Results Compared to a 20 μR/hr Background Value

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/15/00 R fig-4-9

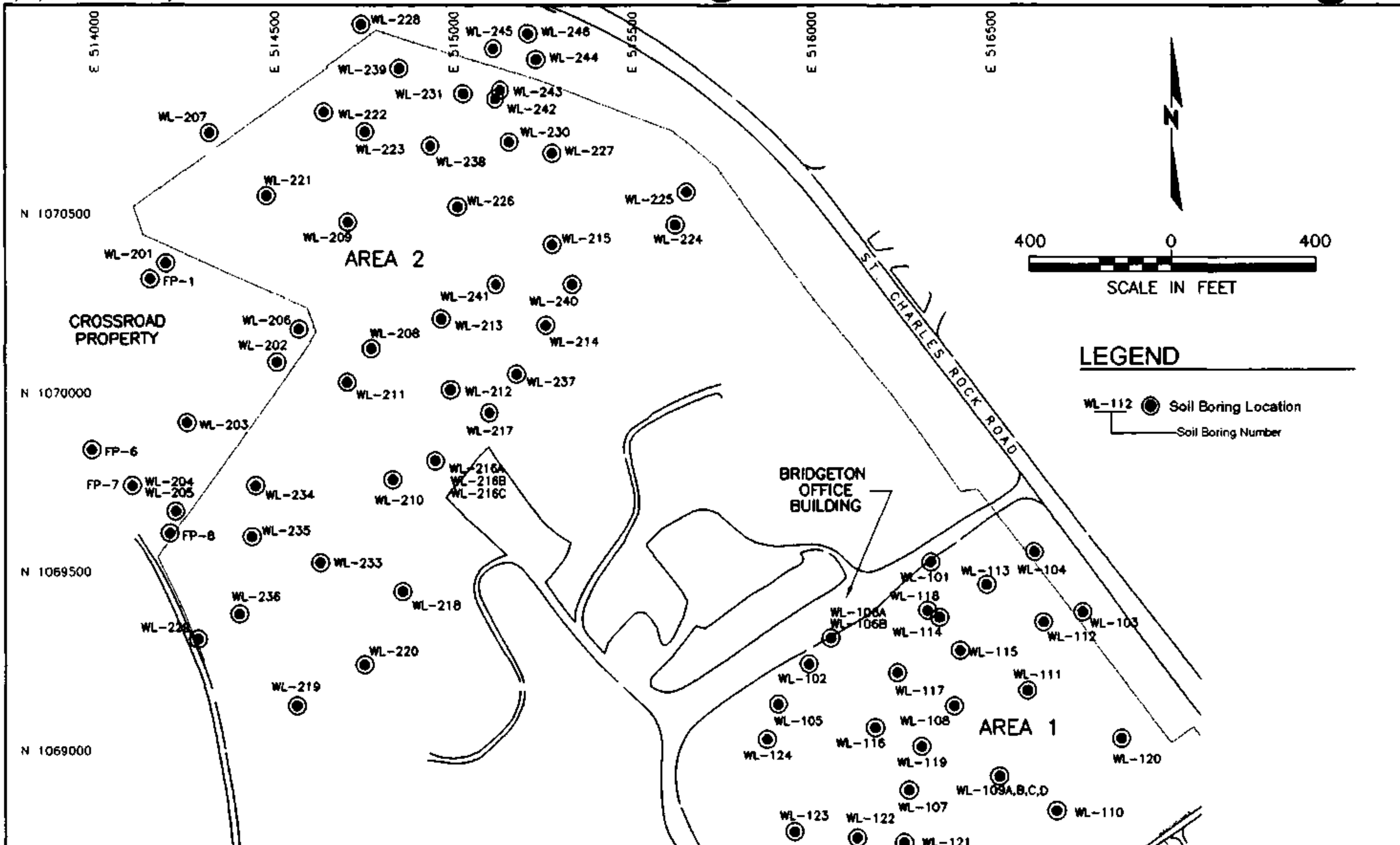


Figure 4-9

Area 1 and 2

Soil Boring Locations

West Lake Landfill OU-1 Remedial Investigation Report

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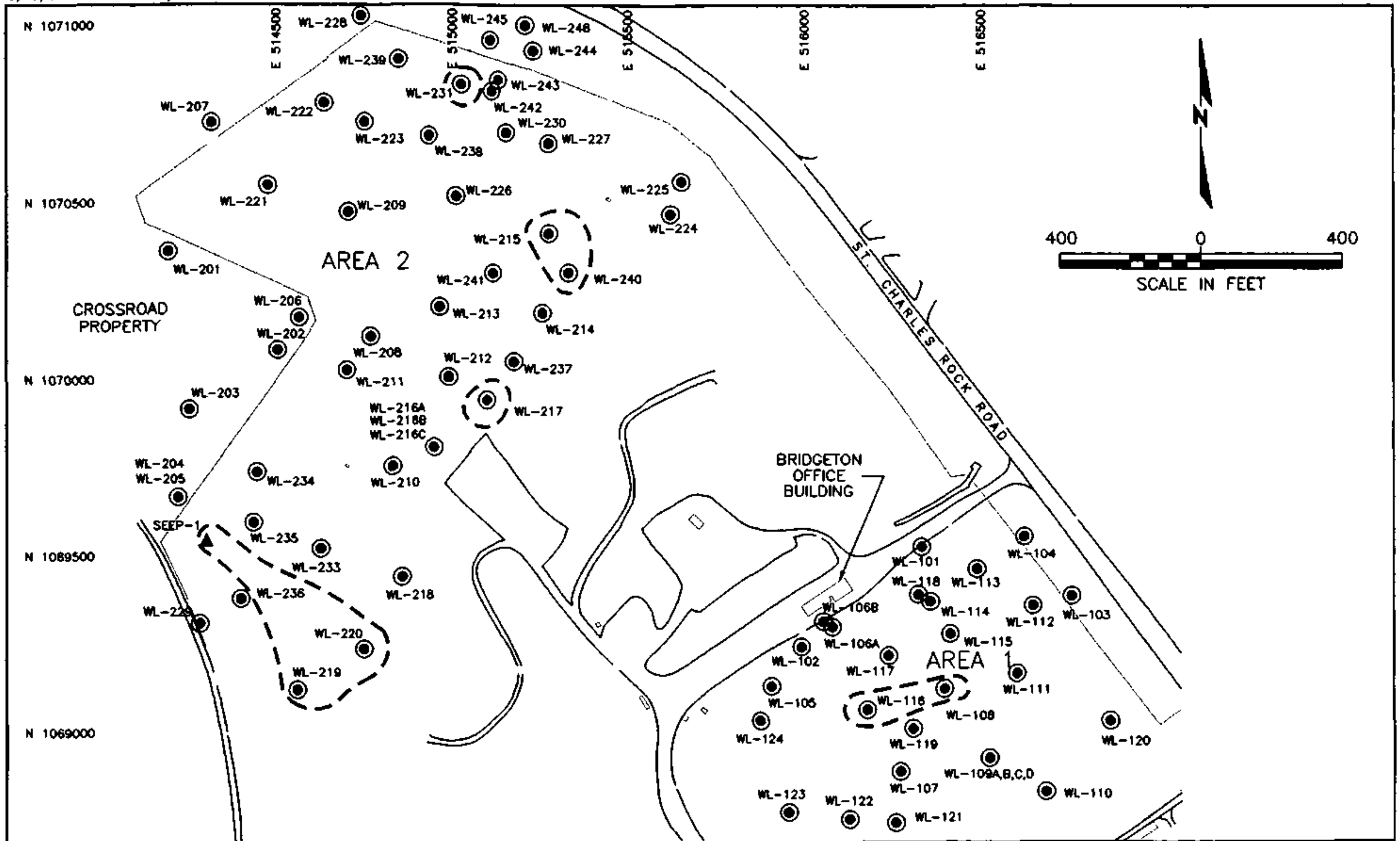
3/15/00 FR fig-4-10



LEGEND

- Soil boring in which perched water was encountered — Soil boring number
- WL-201 Soil boring in which perched water was not encountered — Soil boring number
- SEEP-1 Leachate seep sampling location — Leachate seep sampling number
- Approximate extent of of perched water

Note:
Perched water samples were collected and analyzed from borings WL-108, WL-219, and WL-231.

Figure 4-10

Occurences of Perched Water and Leachate Seepage in Areas 1 and 2

West Lake Landfill OU-1 Remedial Investigation Report

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3/15/00 FR fig-4-11

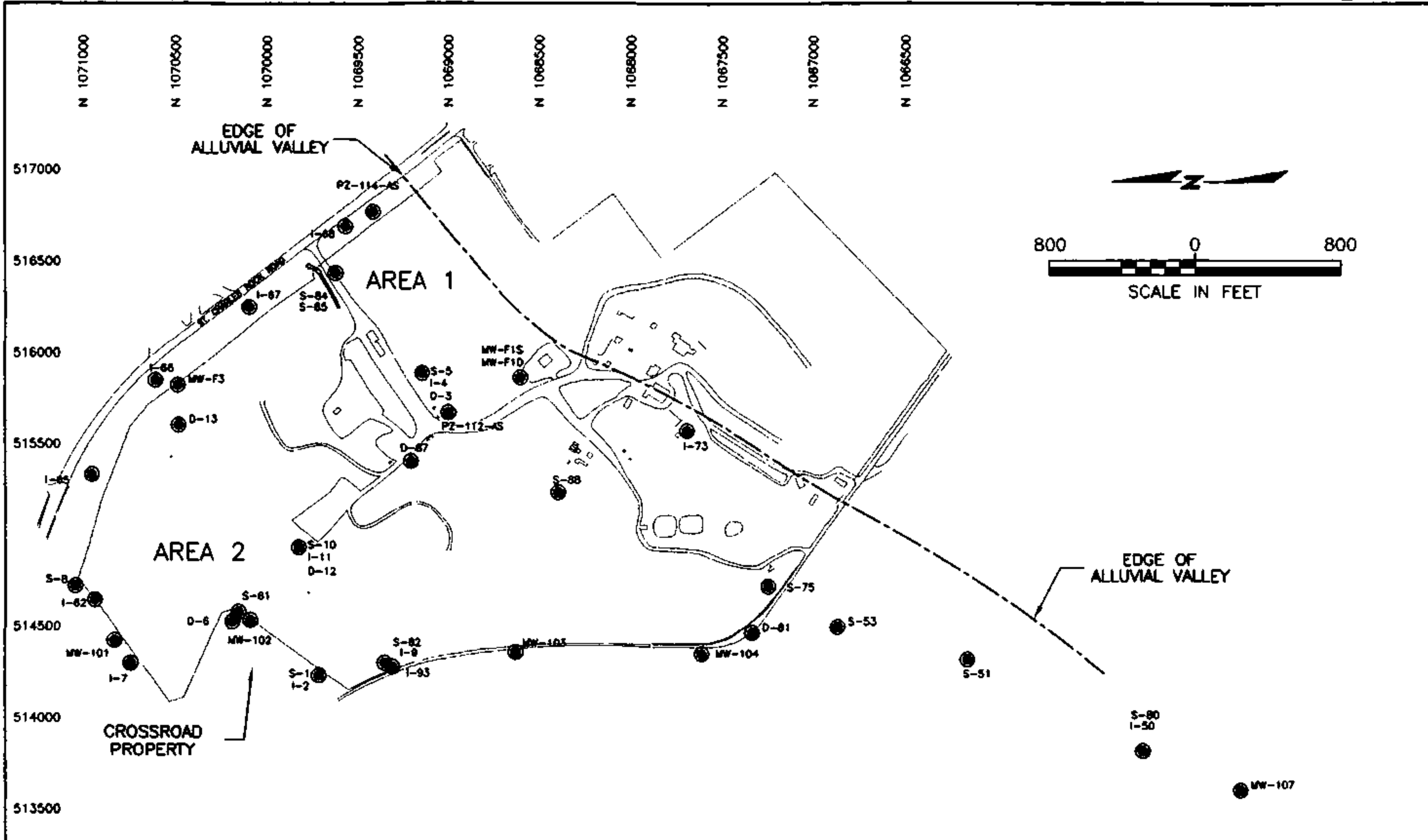


Figure 4-11

Locations of Groundwater Monitoring Level Wells

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/15/00 FR fig-4-12

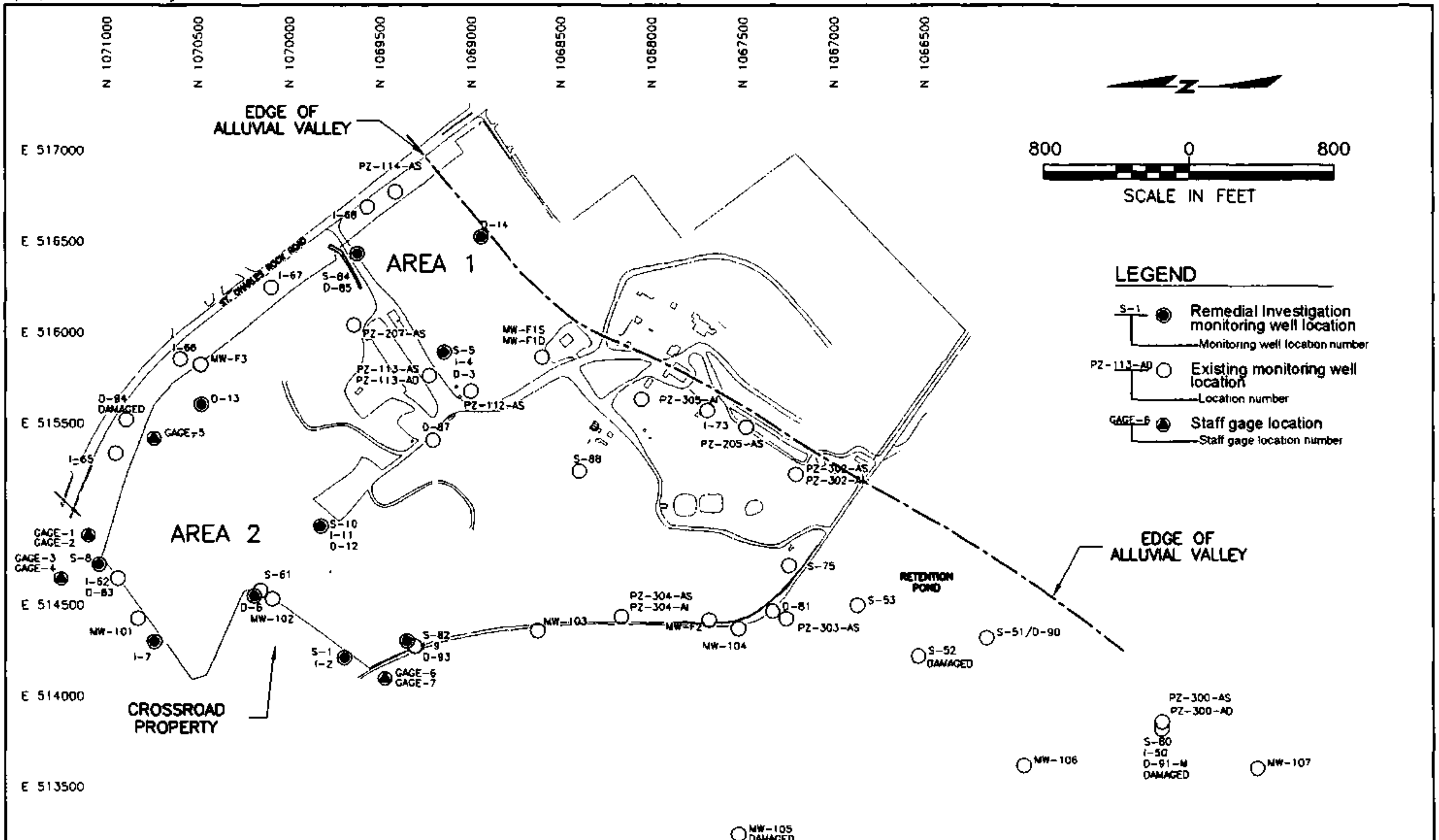


Figure 4-12

Locations of Groundwater Quality Monitoring Wells

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

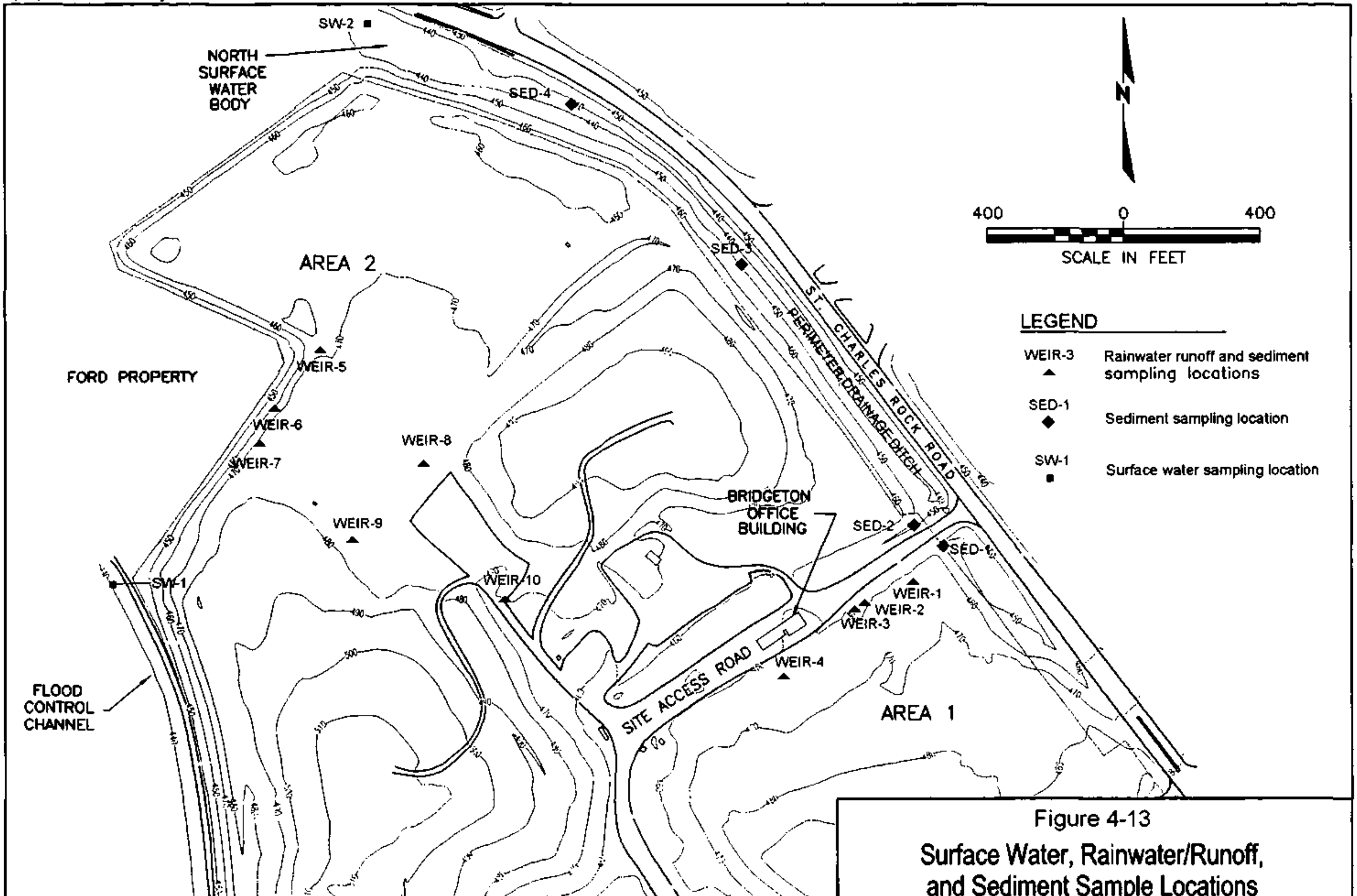


Figure 4-13
Surface Water, Rainwater/Runoff, and Sediment Sample Locations

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/14/00 TC fig-4-14

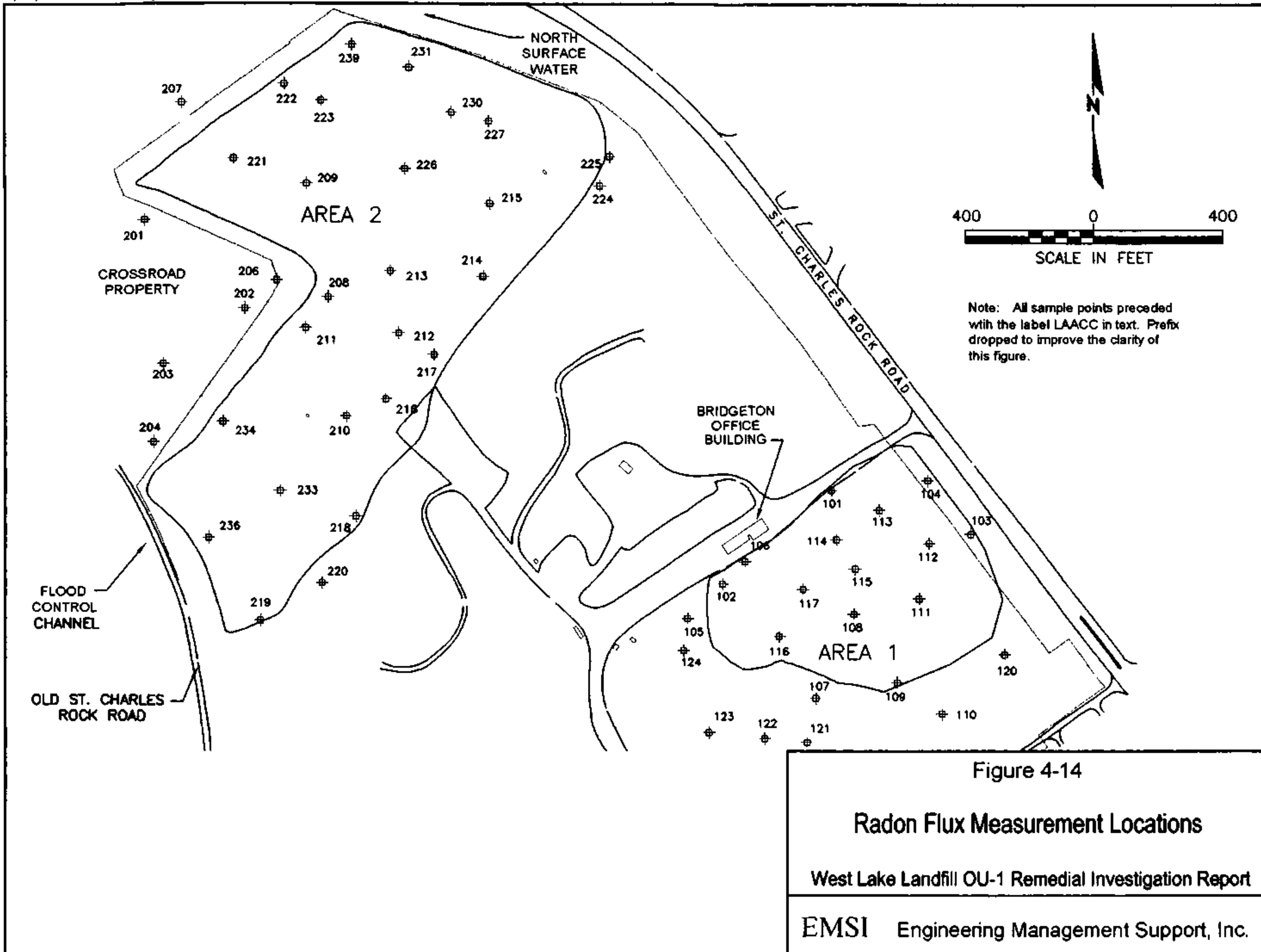


Figure 4-14

Radon Flux Measurement Locations

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/16/00 FR fig-4-15

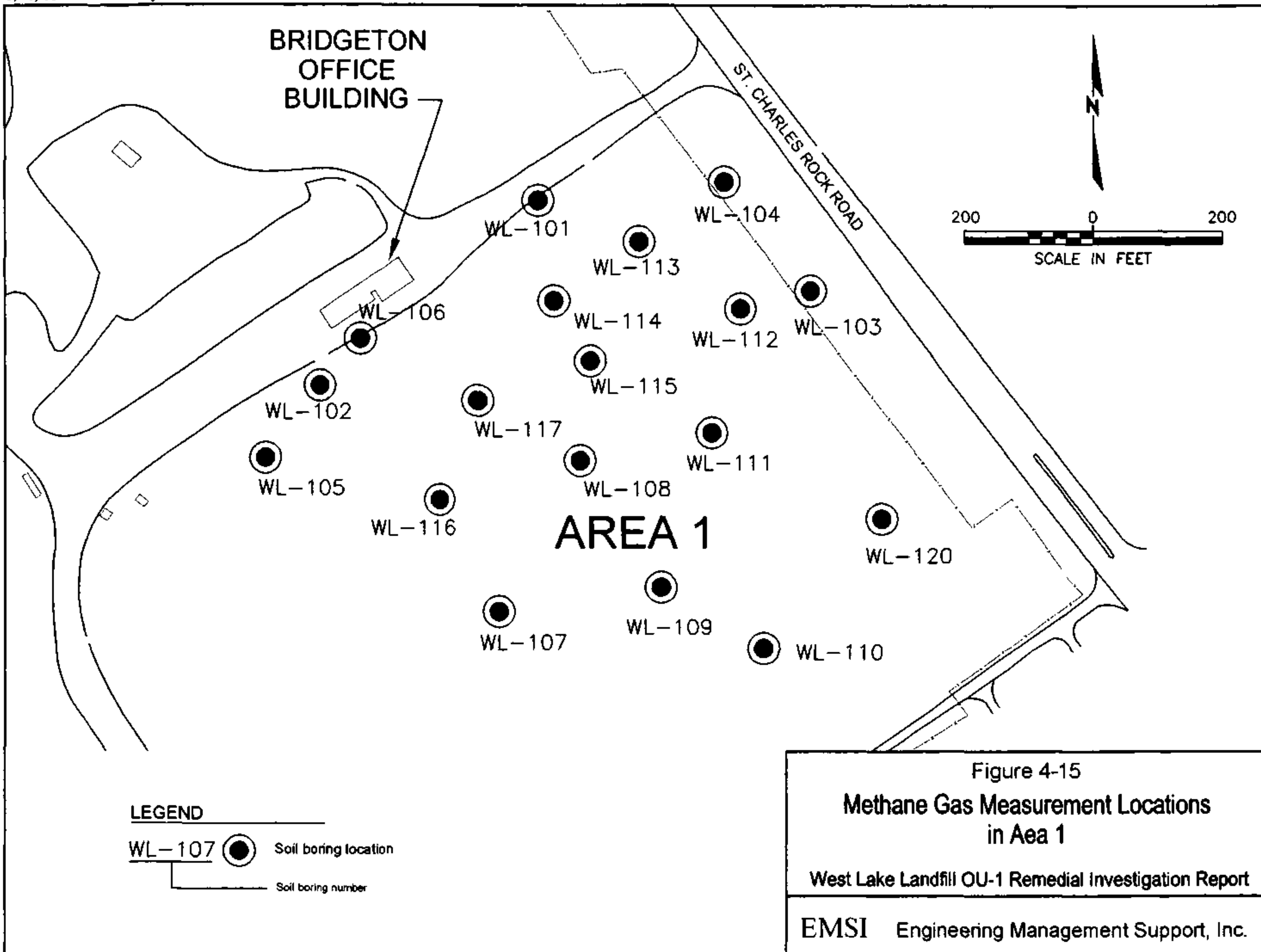


Figure 4-15
Methane Gas Measurement Locations in Aea 1

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

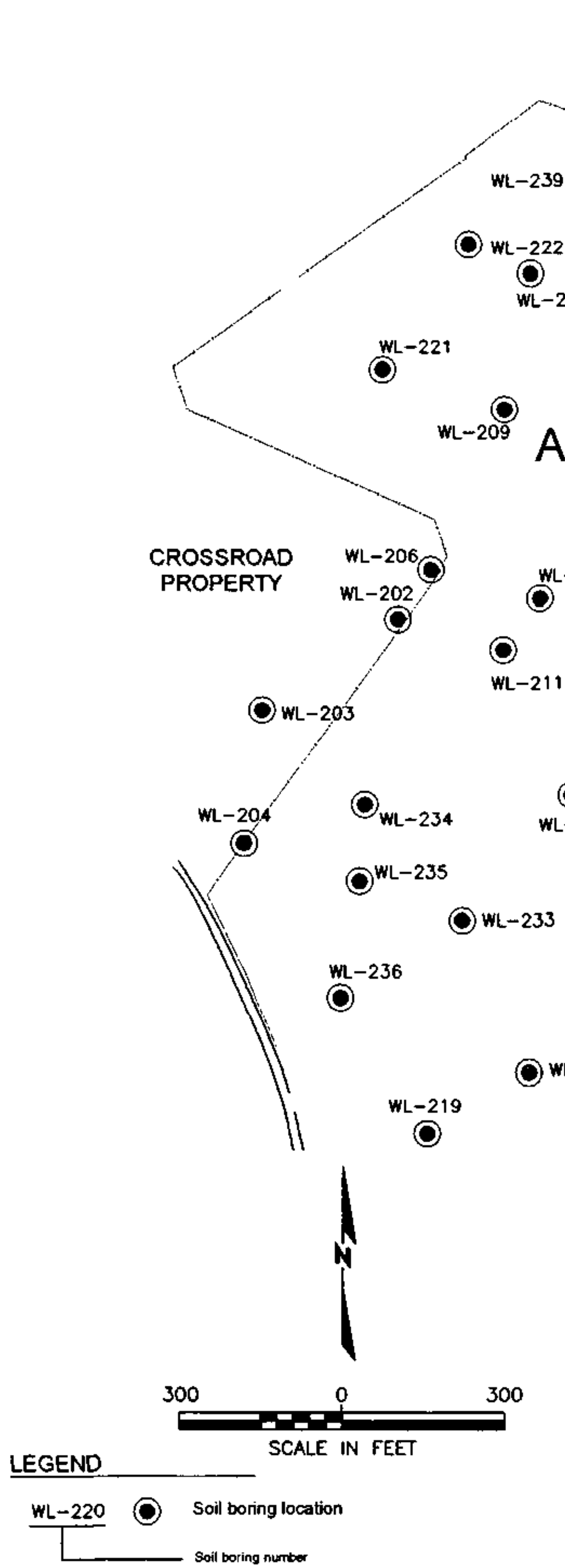
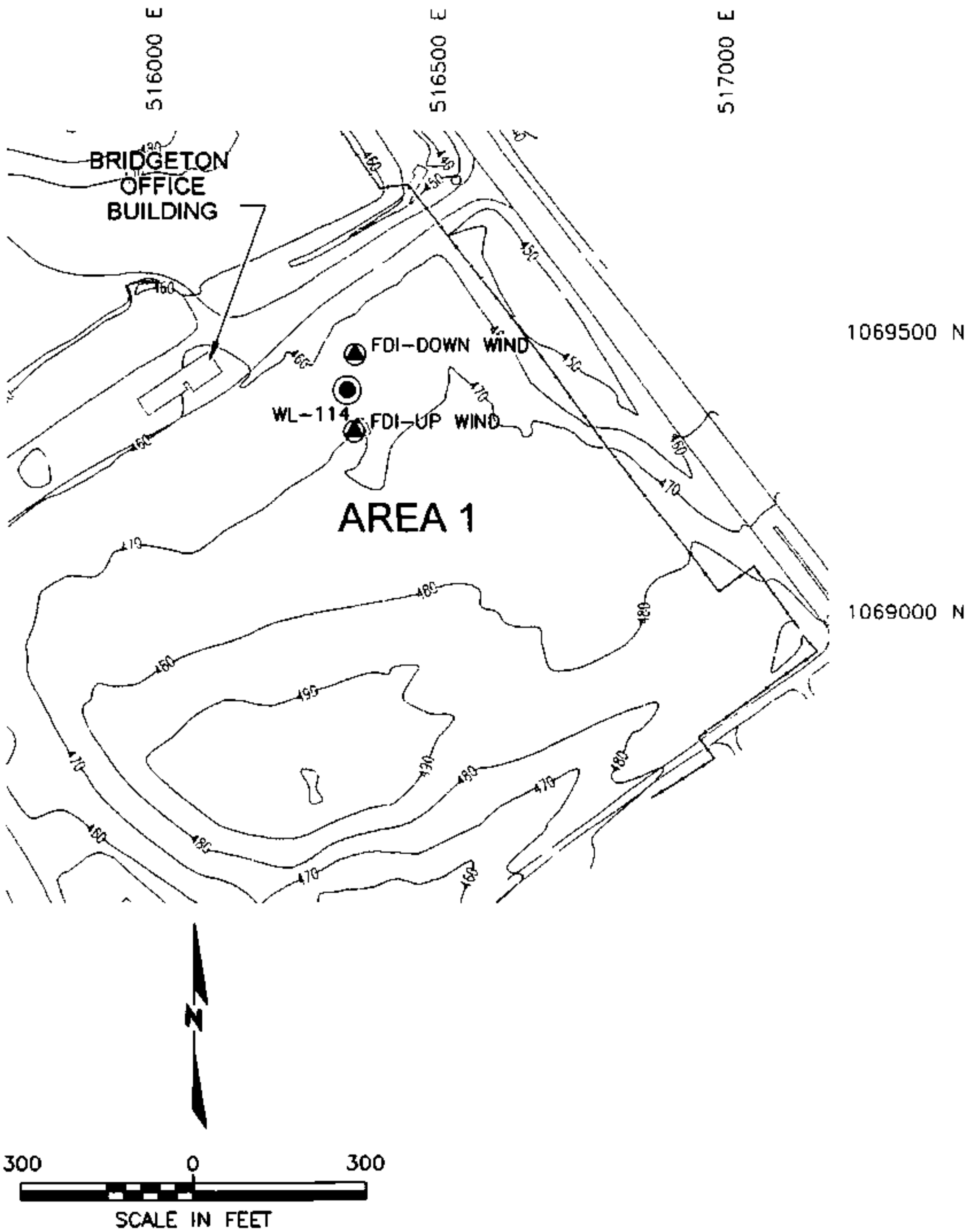


Figure 4-16
Methane Gas Measurement Locations in Area 2

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

4/10/00 FR fig-4-16.dwg



LEGEND

WL-114 ●	Remedial Investigation soil boring location
	Soil boring number
FDI-DOWN WIND ▲	Fugitive dust sampling location

Figure 4-17
Fugitive Dust Monitoring Locations in Area 1

West Lake Landfill OU-1 Remedial Investigation Report

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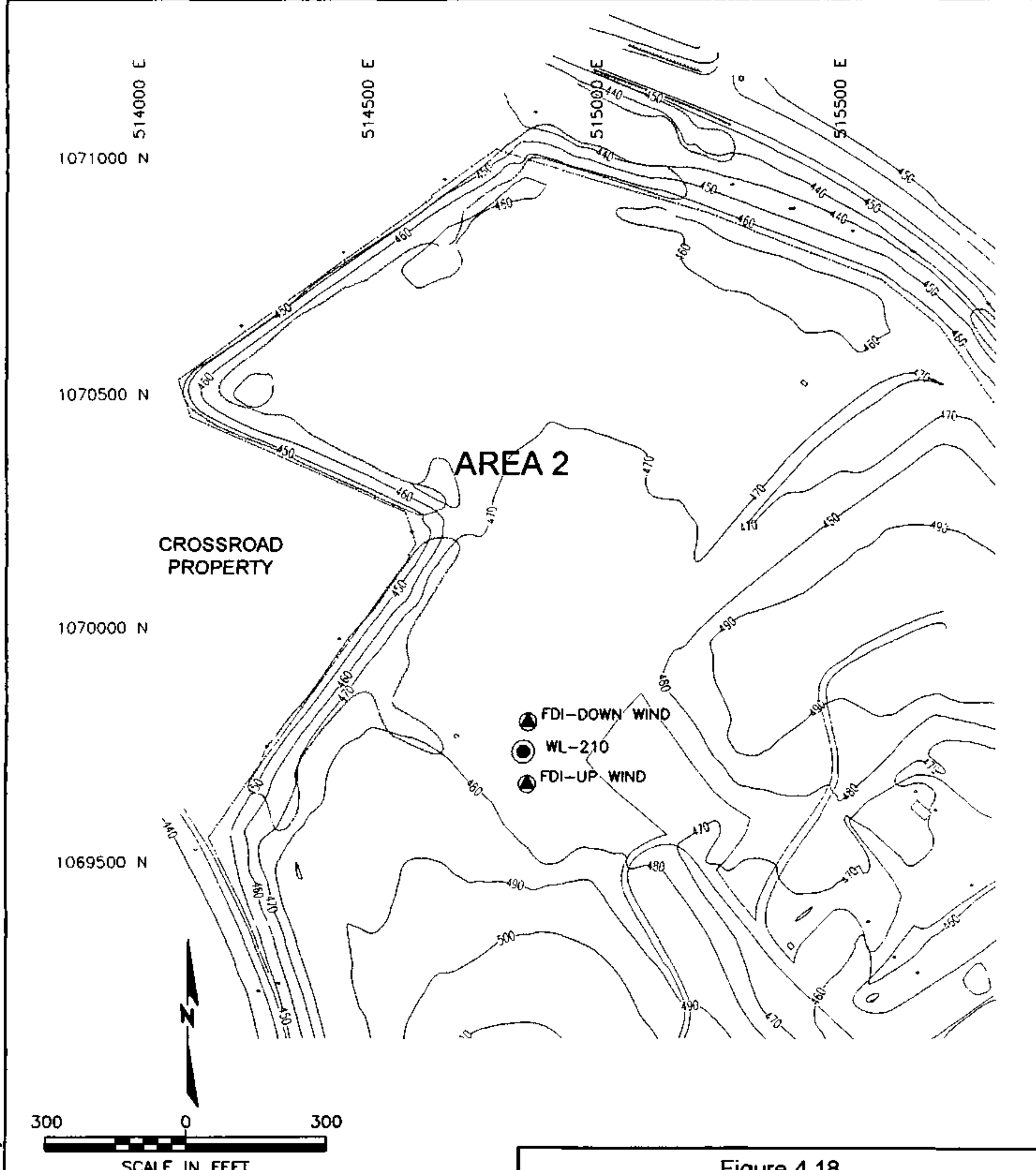
3/16/00 FR fig-4-17.dwg



LEGEND

WL-210 — Remedial Investigation soil boring location (Soil boring number)

FDI-DOWN WIND — Fugitive dust sampling location

Figure 4-18
Fugitive Dust Monitoring Locations in Area 2

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/16/00 FR fig-4-18.dwg

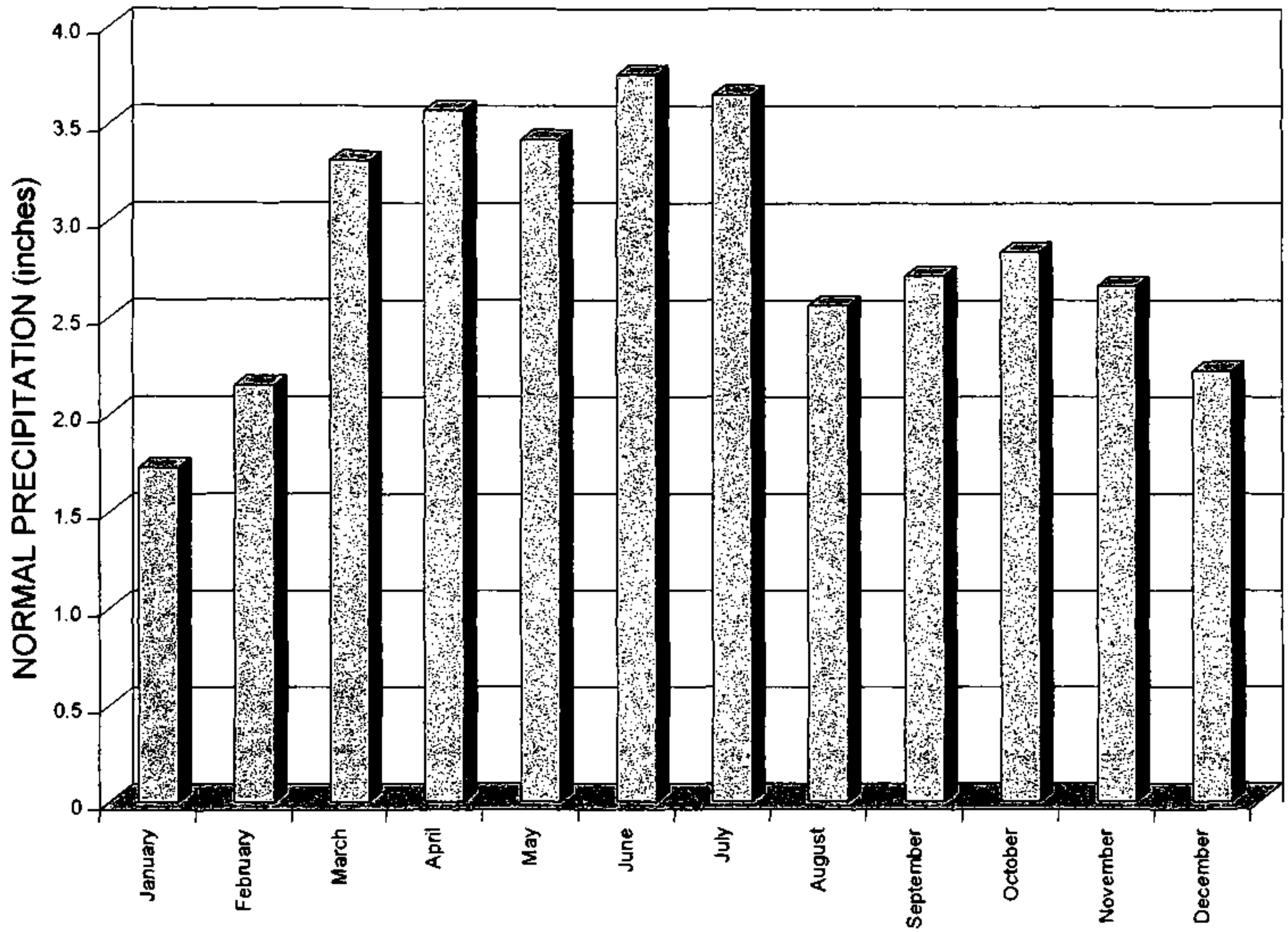


Figure 5-1

Normal Monthy Precipitation for St. Louis Lambert International Airport

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

System	Series	Group	Formation	Thickness (ft)	Dominant Lithology	Water-Bearing Character
Quaternary	Holocene		Alluvium	0-150	Sand, gravel, silt, and clay	Some wells yield more than 2,000 gpm.
	Pleistocene		Loess Glacial Till	1-110 0-55	Silt Pebbly clay and silt	Essentially not water yielding.
Pennsylvanian	Missourian	Pleasanton	Undifferentiated	0-75	Shales, siltstones, "dirty" sandstones, coal beds and thin limestone beds.	Generaly yields very small quantities of water to wells. Yields range from 0 to 10 gpm.
	Desmoinesian	Marmaton	Undifferentiated	0-90		
		Cherokee	Undifferentiated	0-200		
	Atokan		Cheltenham Formation	unknown		
Mississippian	Meremacian		Ste. Genevieve Formation	0-160	Argillaceous to arenaceous limestone.	Yields small to moderate quantities of water to wells. Yields range from 5 to 50 gpm. Higher yields are reported for this interval locally
			St. Louis Limestone	0-180		
			Salem Formation	0-180		
			Warsaw Formation	0-110	Shales in upper portion, limestone in lower portions.	
	Osagean		Burlington-Keokuk Formation	0-240	Cherty limestone.	
			Fern Glen Formation	0-105	Red limestone and shale.	
	Kinderhookian	Chouteau	Undifferentiated	0-122	Limestone, dolomitic limestone, shale, and siltstone.	
Devonian	Upper	Sulphur Springs	Bushberg Sandstone	0-60	Limestone and sandstone.	
			Glen Park Limestone			
			Grassy Creek Shale	0-50	Fissile, carbonaceous shale	
Silurian			Undifferentiated	0-200	Cherty limestone.	
Ordovician	Cincinnatian		Maquoketa Shale	0-163	Silty, calcereous or dolomitic shale.	Probably constitutes a confining influence on water movement
			Cape Limestone	0-5	Argillaceous limestone.	Yields small to moderate quantities of water to wells. Yields range from 3 to 50 gpm. Decorah Formation probably acts as a confining bed locally.
	Champlainian		Kimmswick Formation	0-145	Massive limestone.	
			Decorah Formation	0-50	Shale with interbedded limestone	
			Plattin Formation	0-240	Finely crystalline limestone.	
			Rock Levee Formation	0-93	Dolomite and limestone, some shale.	
			Joachim Dolomite	0-135	Primarily argillaceous dolomite.	
			St. Peter Sandstone	0-160	Silty sandstone, cherty limestone grading upward into quartzose sandstone	Yields moderate quantities of water to wells. Yields range from 10-140 gpm.
			Everton Formation	0-130		
	Canadian		Powell Dolomite	0-150	Sandy and cherty dolomites and sandstone.	Yields small to large quantities of water to wells. Yields range from 10 to 300 gpm. Upper part of aquifer group yields only small amounts of water to wells
			Cotter Dolomite	0-320		
			Jefferson City Dolomite	0-225		
			Roubidoux Formation	0-177		
			Gasconde Dolomite Gunter Sandstone Member	0-280		
Cambrian	Upper		Eminence Dolomite	0-172	Cherty dolomites, siltstones, sandstone, and shale.	Yields moderate to large quantities of water to wells. Yields range from 10 to 400 gpm.
			Potosi Dolomite	0-325		
		Elvins	Derby-Doerun Dolomite	0-165		
			Davis Formation	0-150		
Precambrian					Igneous and metamorphic rocks.	Does not yield water to wells in this area

From Golder Associates, 1996a Table 2-1

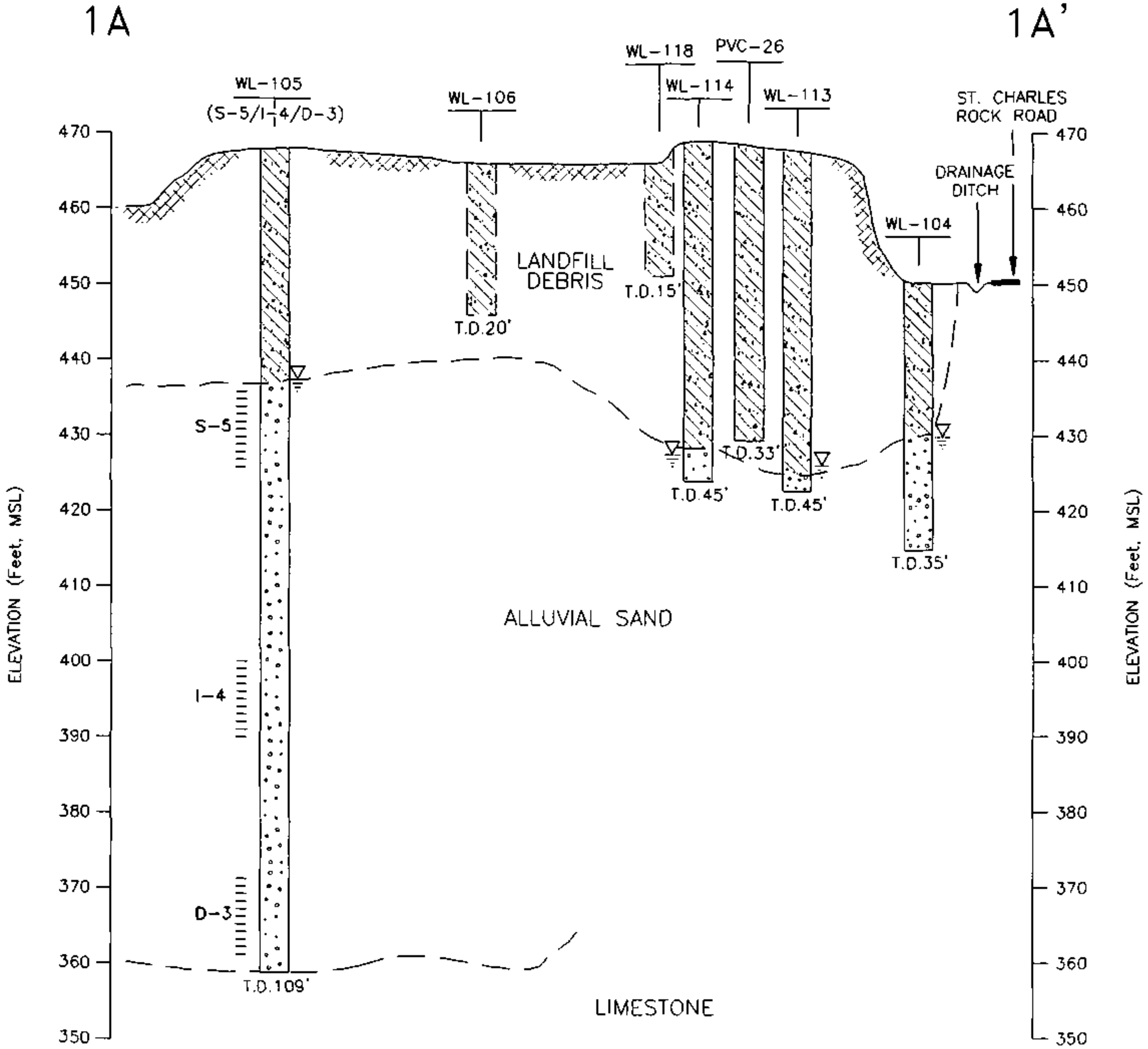
Figure 5-2

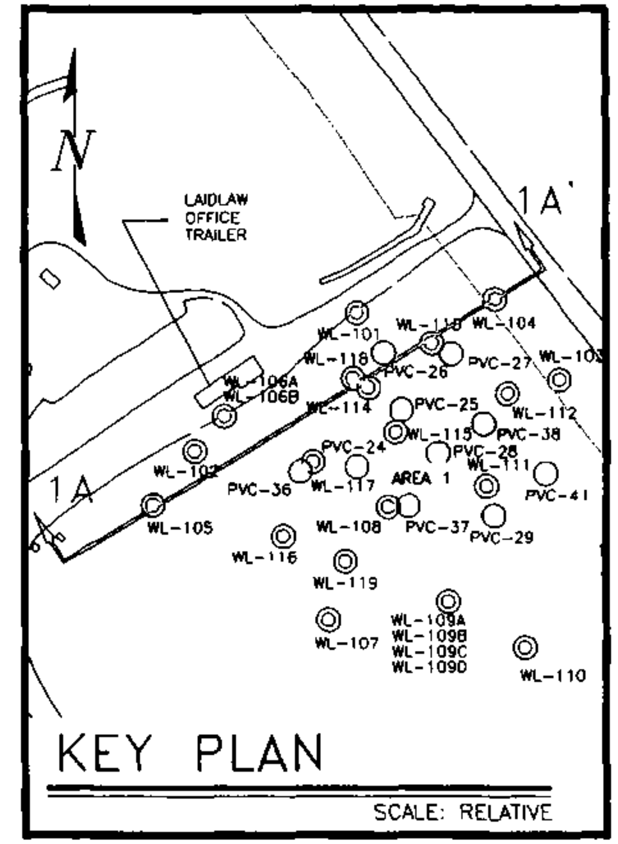
Generalized Stratigraphic Column for the St. Louis Area

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/16/00 FR fig-5-2.dwg





LEGEND

LANDFILL DEBRIS

ALLUVIAL SAND

WL-106 — DESIGNATES DEPTH AT WHICH WATER WAS ENCOUNTERED

PROJECTED SOIL BORING

T.D. — TOTAL DEPTH BELOW GROUND SURFACE (T.D.20')

APPROXIMATE LIMITS OF ELEVATED GAMMA READINGS BASED ON OVERLAND GAMMA SURVEY AND DOWNHOLE GEOPHYSICAL LOGGING

HORIZONTAL SCALE: 0 100 200 400 FEET

VERTICAL SCALE: 0 10 20 40 FEET

This figure was previously Figure 3-3 from the Soil Boring / Surface Sample Investigation Report (McLaren/Hart, 1996). The only modification was change of figure number from 3-3 to 5-3.

Figure 5-3

Cross Section 1A-1A'

West Lake Landfill OU-1 Remedial Investigation Report

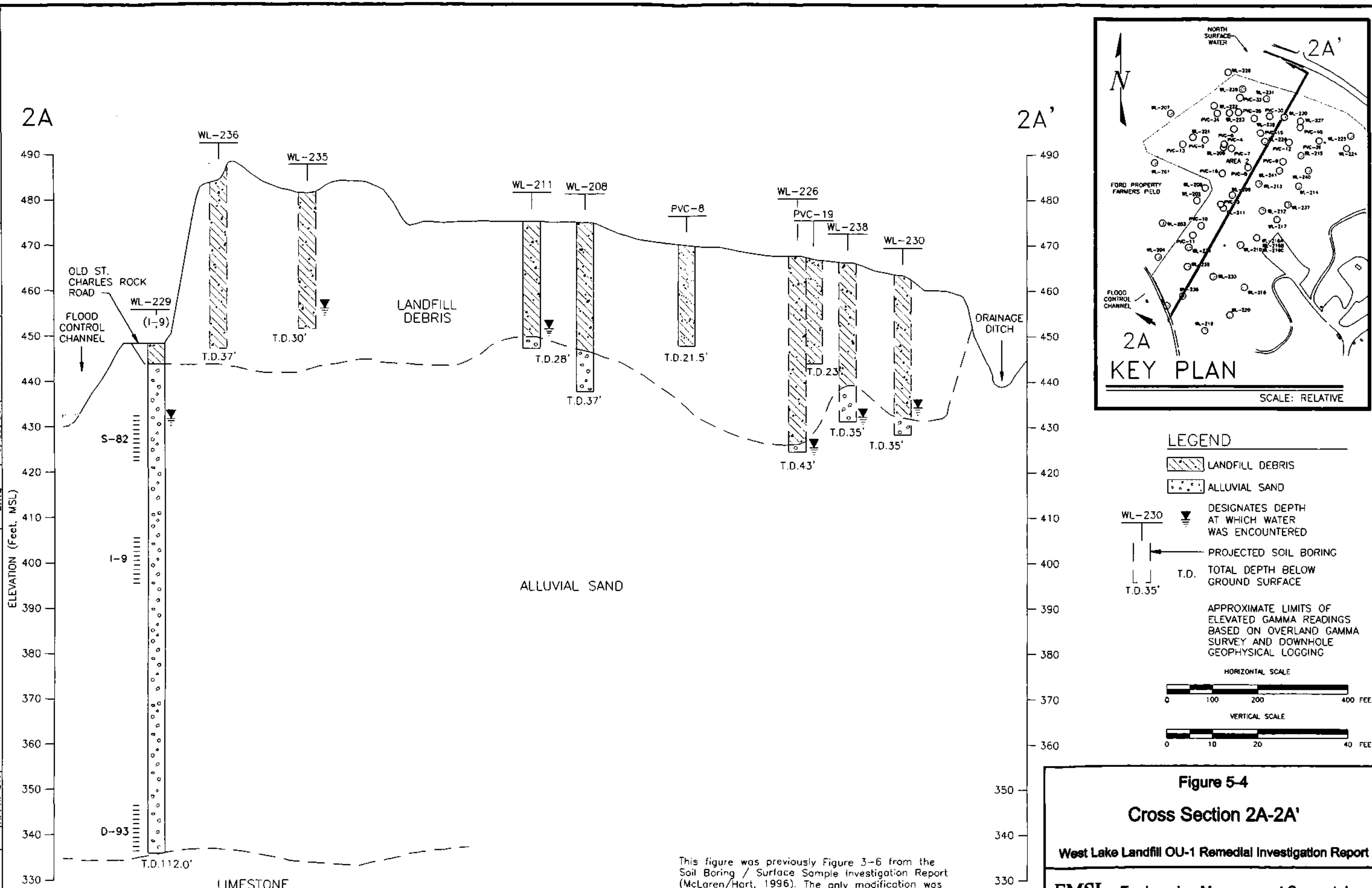
EMSI **Engineering Management Support, Inc.**

DRAWING NUMBER 556-B107

DRAWN BY: DAG | DATE 10/29/96 | CHECKED BY | APPROVED BY

REVISIONS | No. | DESCR. | APPR. BY:

4/5/00 Fig-5-3



This figure was previously Figure 3-6 from the Soil Boring / Surface Sample Investigation Report (McLaren/Hart, 1996). The only modification was change of figure number from 3-6 to 5-4

Figure 5-4

Cross Section 2A-2A'

West Lake Landfill OU-1 Remedial Investigation Report

EMSI **Engineering Management Support, Inc.**

DRAWING NUMBER 556-8095

DRAWN BY: DAG DATE 10/29/96

CHECKED BY APPROVED BY

REVISIONS DESCR. APPR. BY:

4/5/00 Fig-5-4

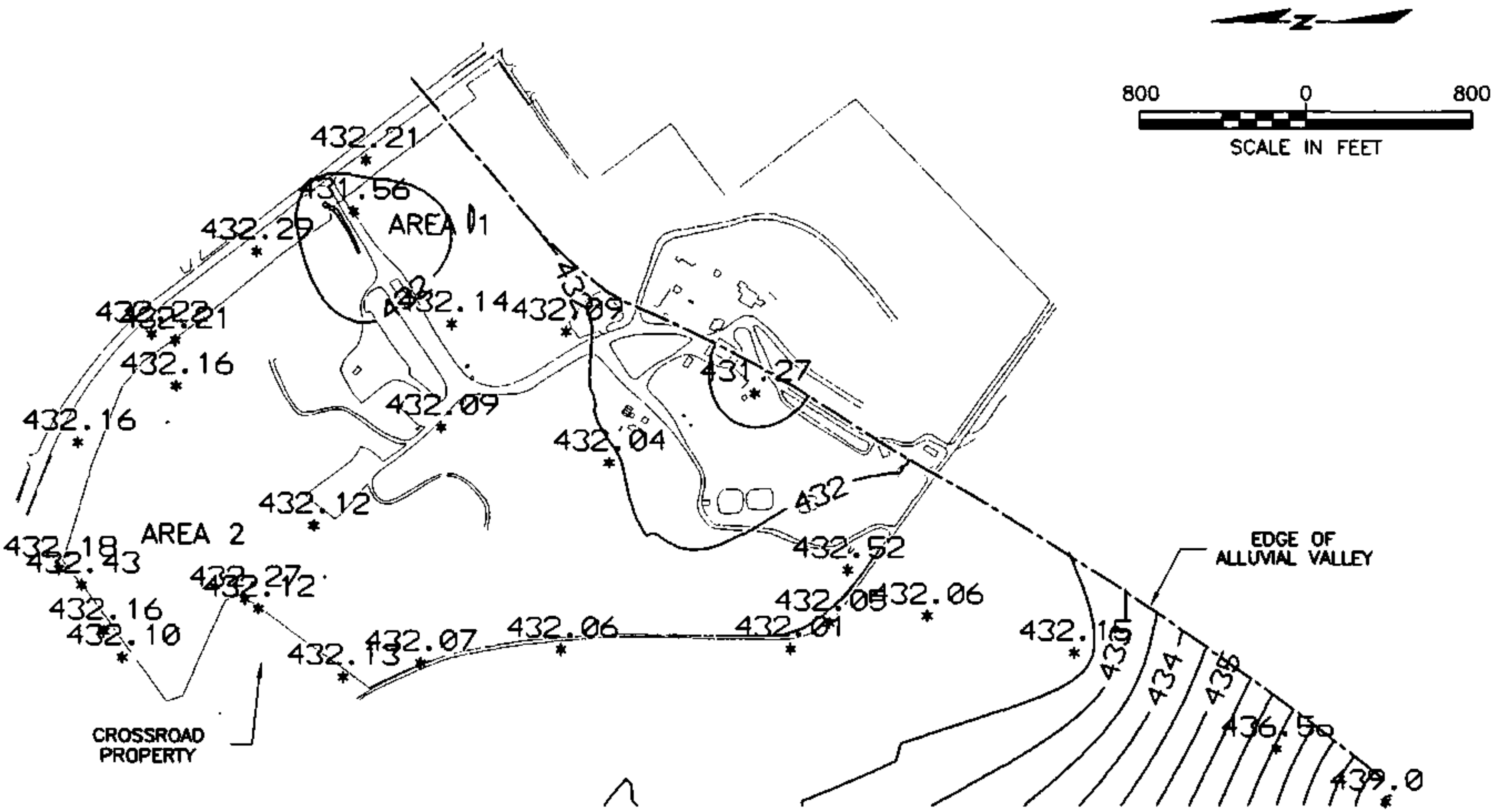


Figure 5-5

Alluvial Aquifer Water Table Map - October, 1995

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/15/00 FR fig-5-6.dwg

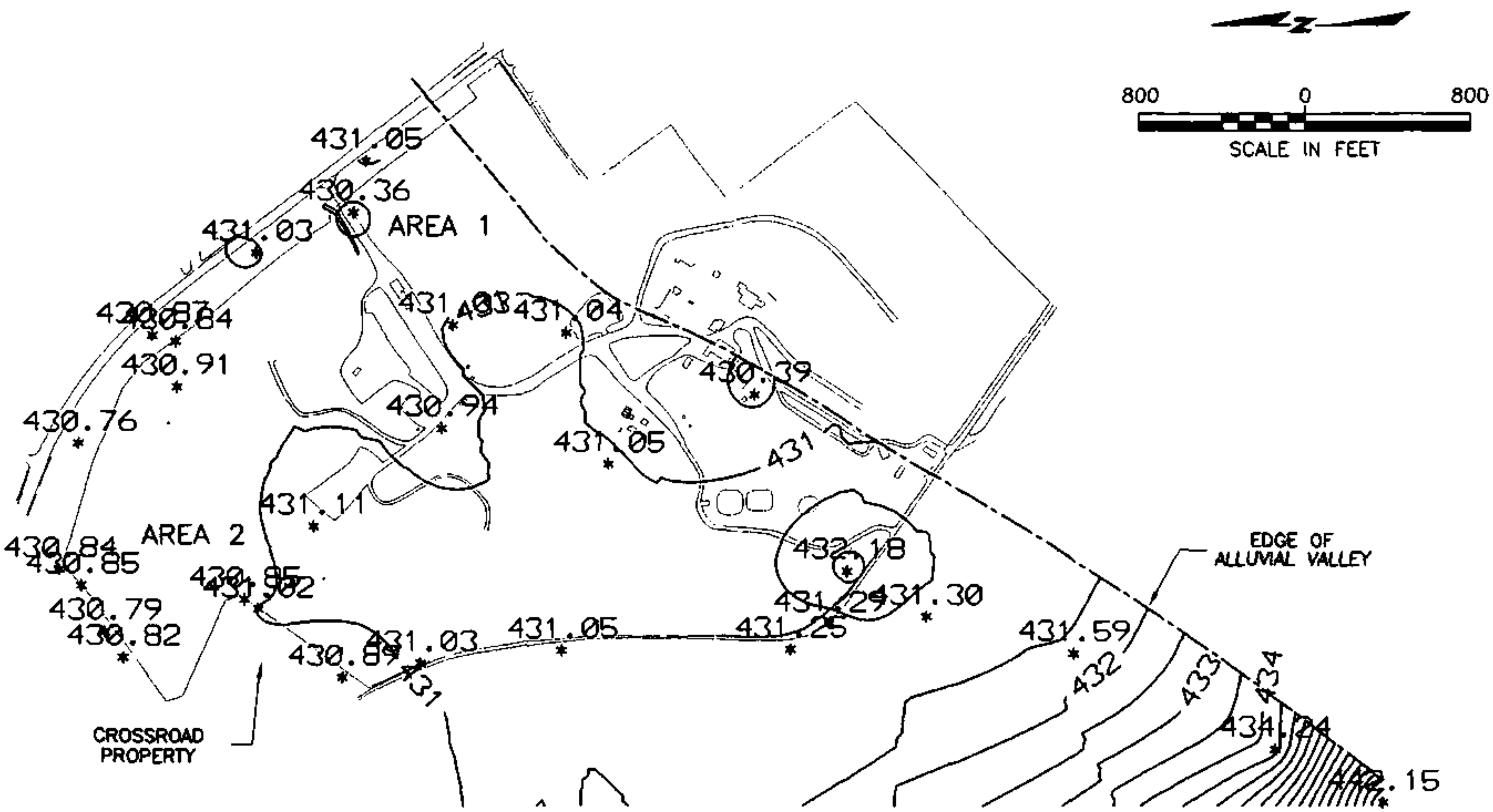


Figure 5-6

Alluvial Aquifer Water Table Map - January, 1996

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

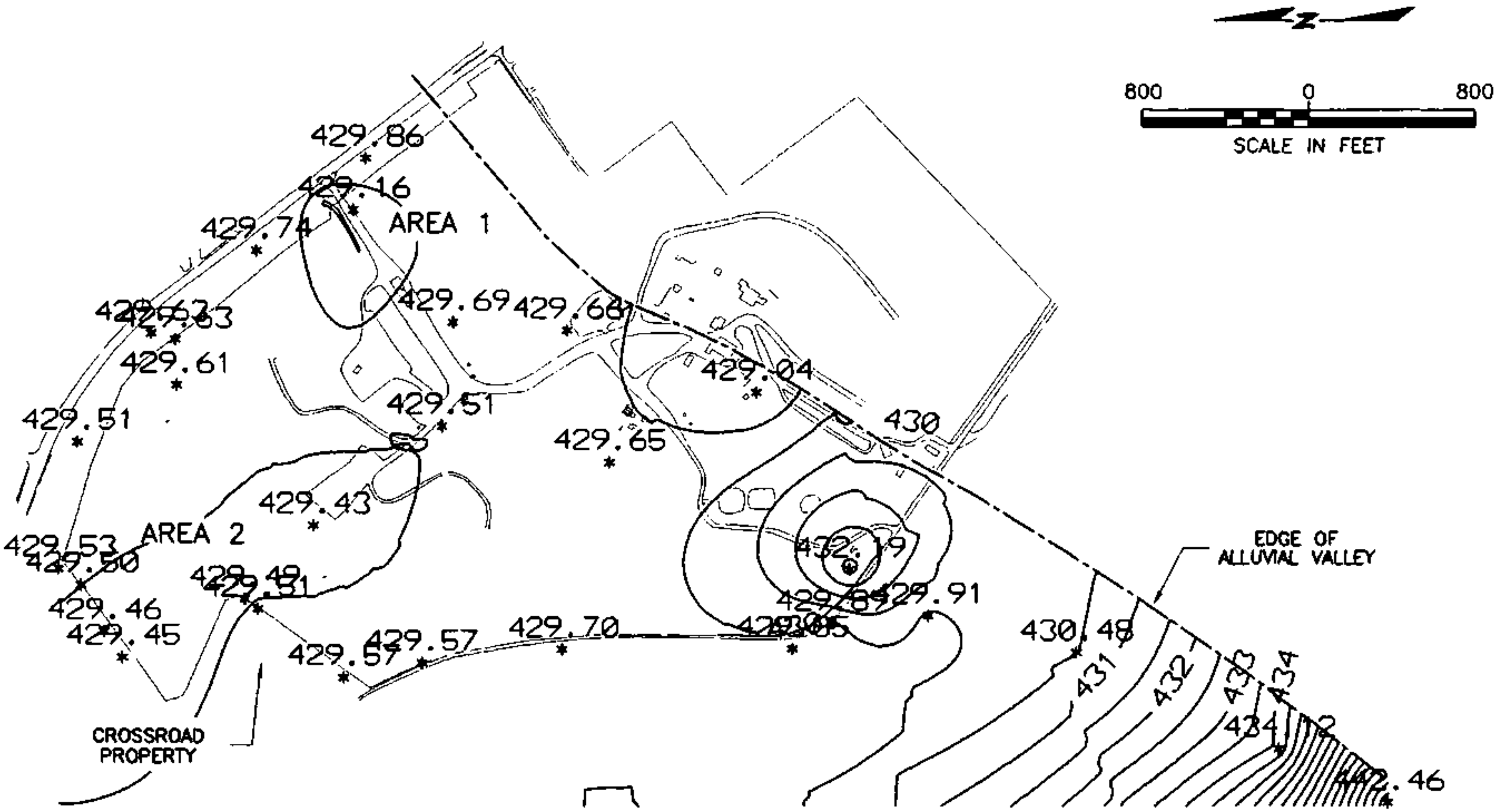


Figure 5-7

Alluvial Aquifer Water Table Map - April, 1996

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

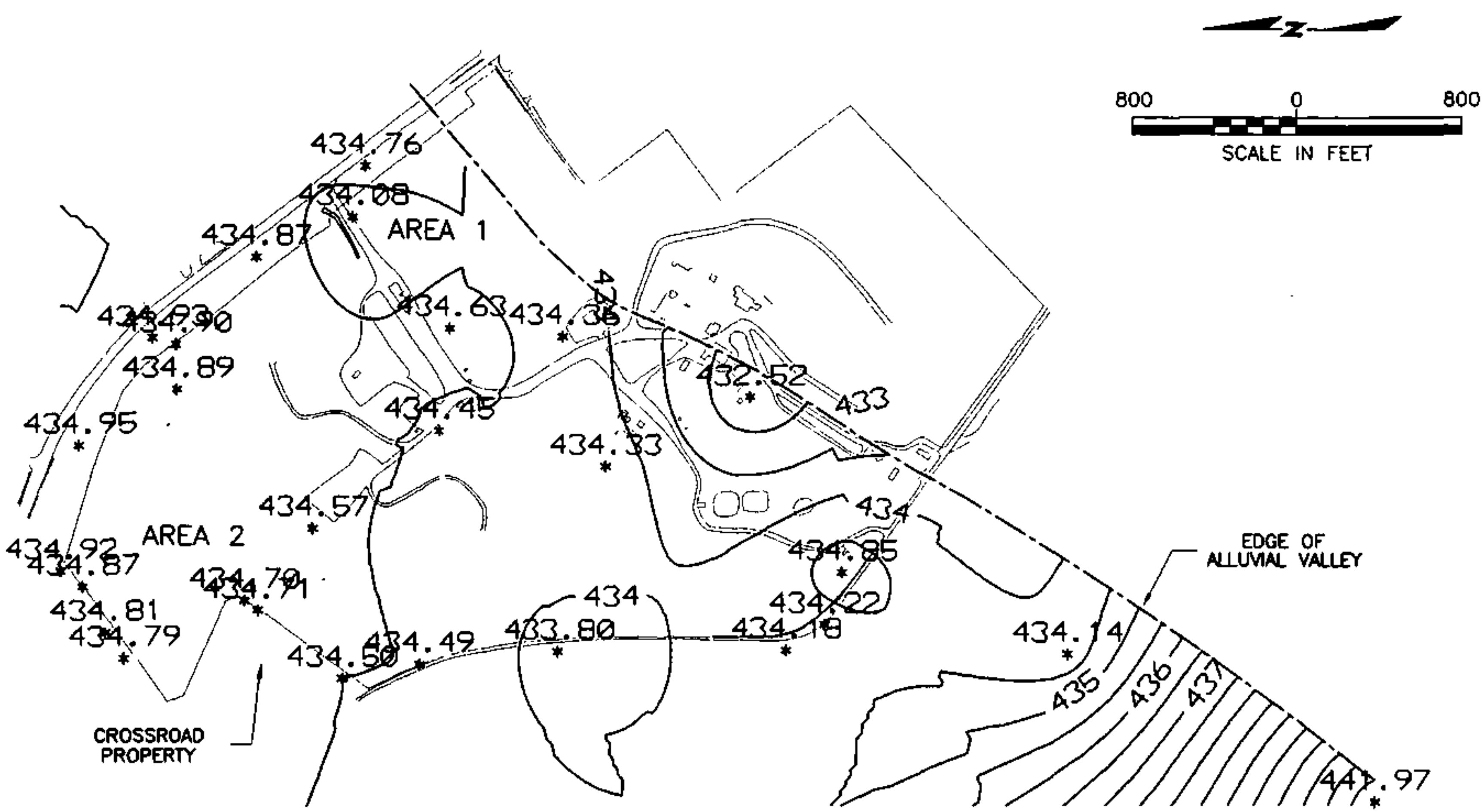
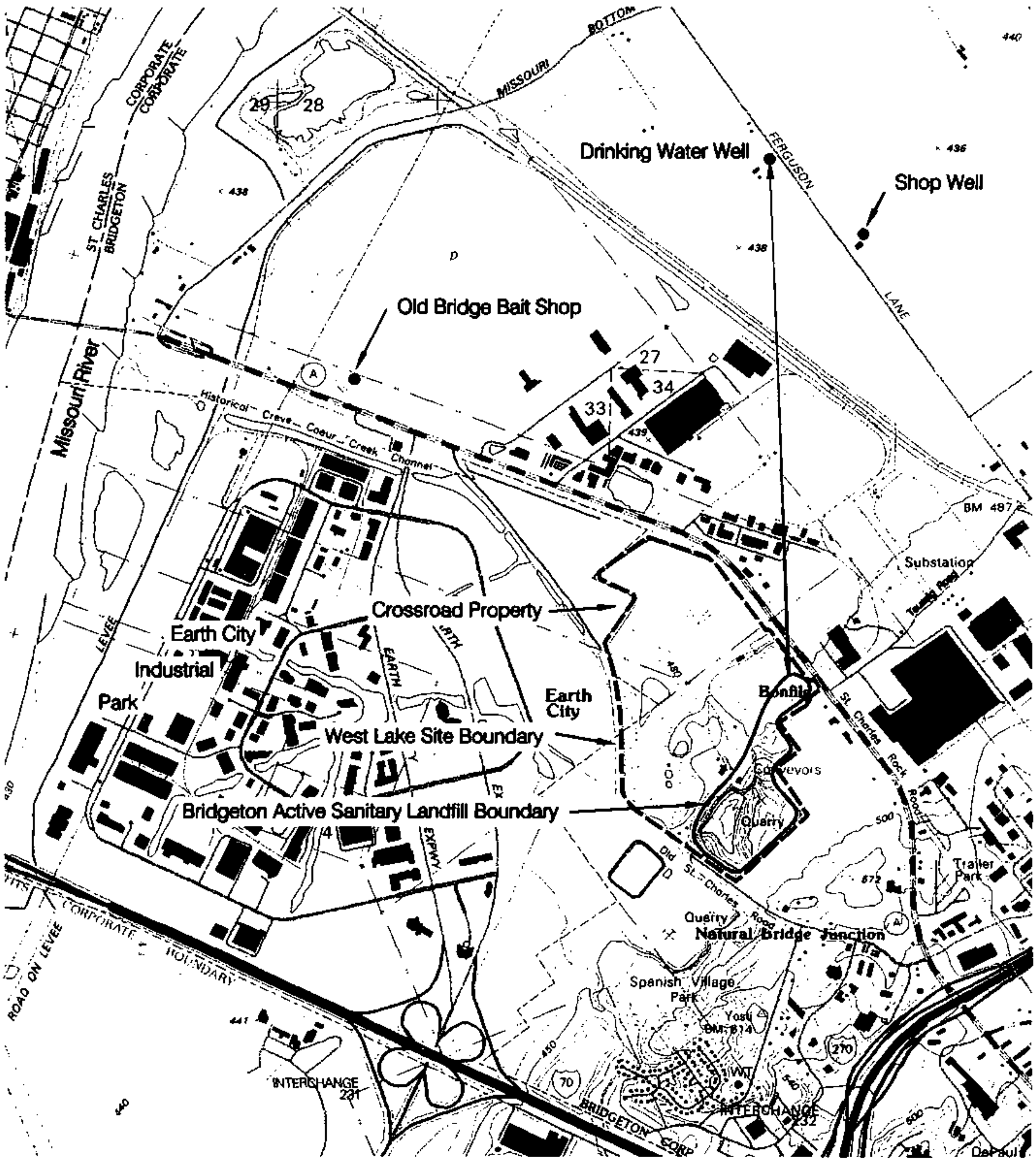


Figure 5-8

Alluvial Aquifer Water Table Map - July, 1996

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.



Source: St. Charles, MO USGS 7.5' Quadrangle, 1994, and Foth and Van Dyke, Feb. 10, 1994.

2000 0 2000
SCALE IN FEET

N

Figure 5-9

Water Wells in the Vicinity of the West Lake Landfill

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/13/00 FR fig-5-9.dwg

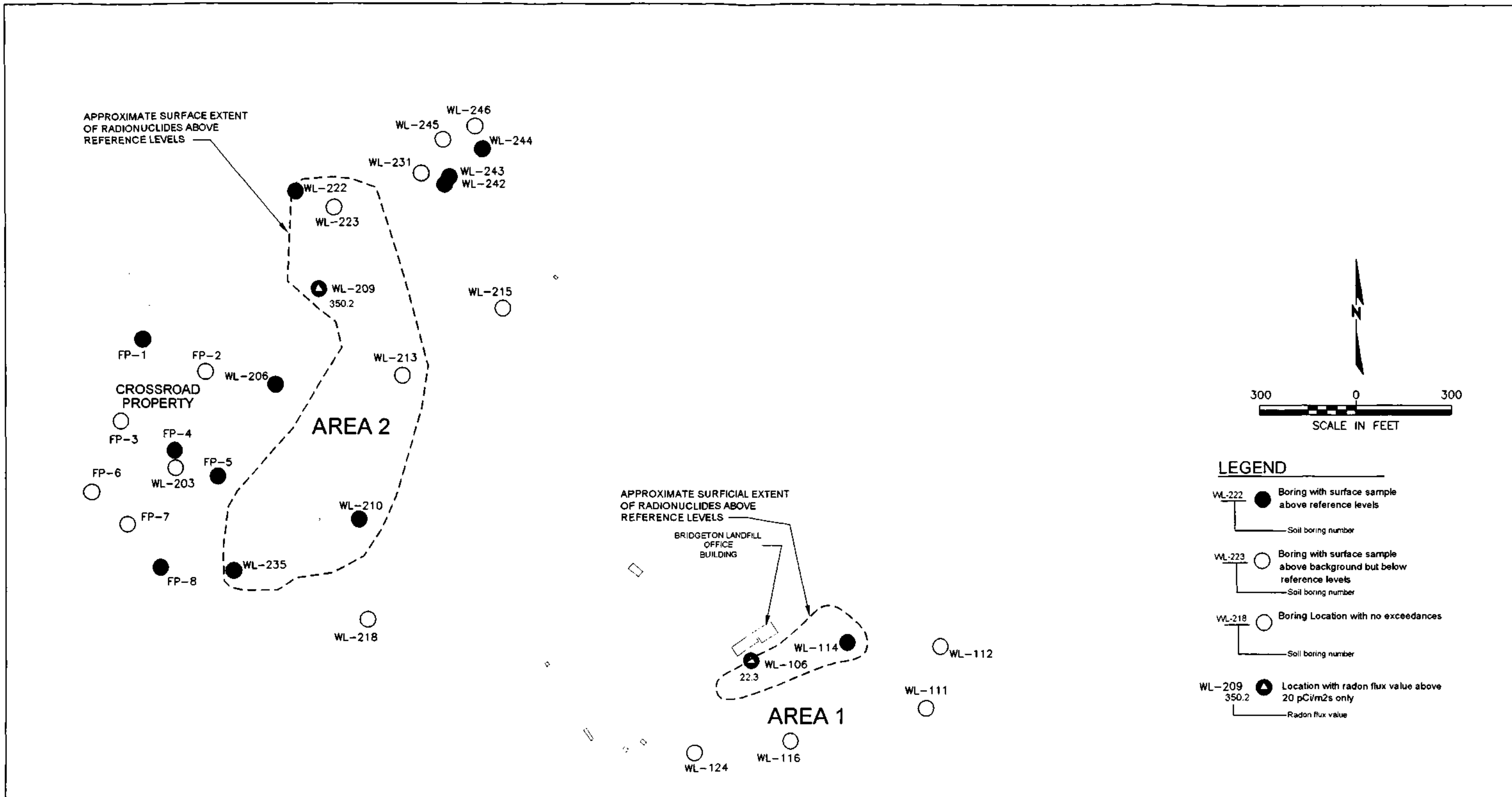


Figure 6-1
Approximate Extent of Radionuclide Impacted Materials at the Landfill Surface

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

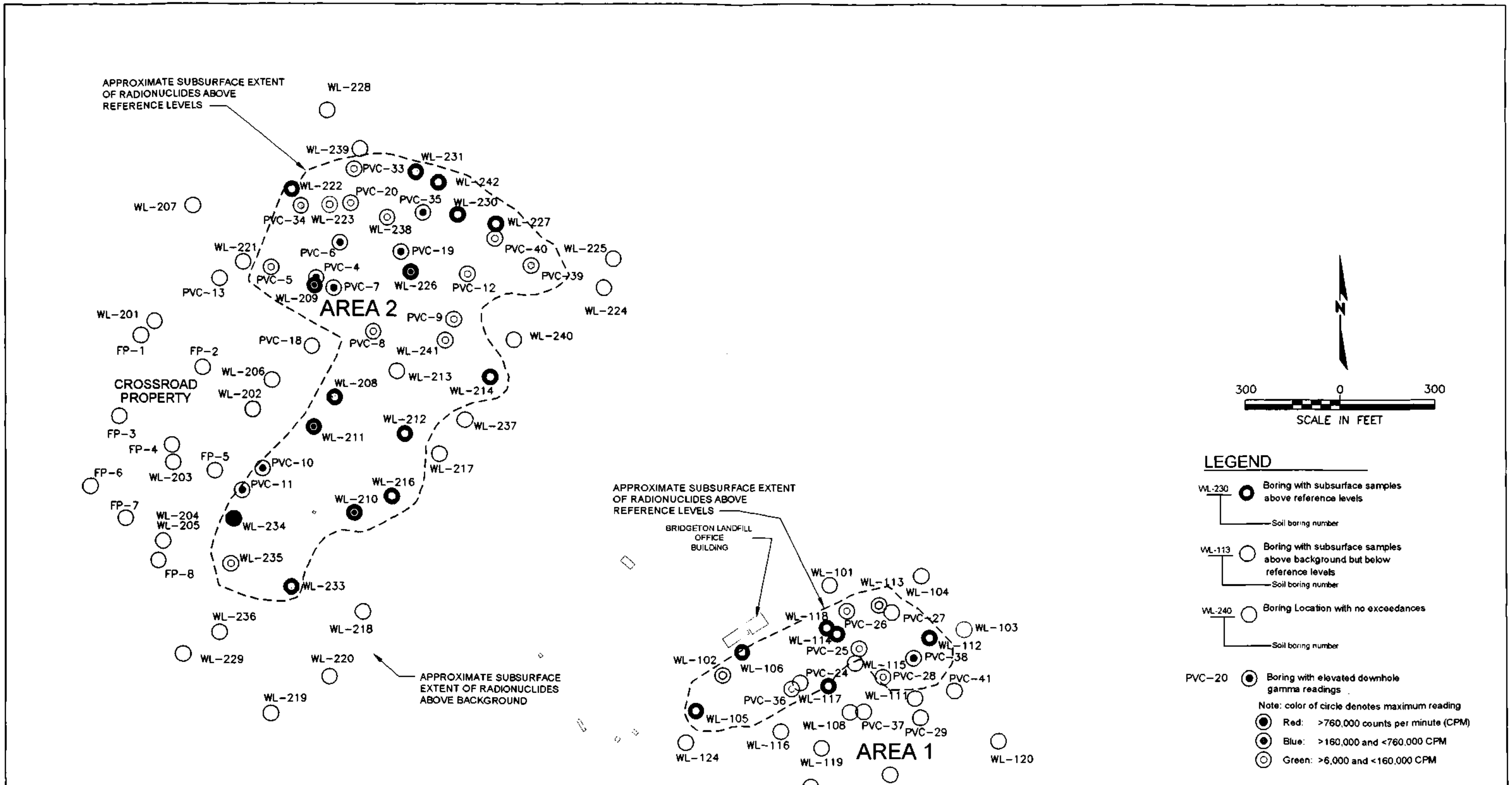


Figure 6-2

Approximate Extent of Radionuclide Impacted Materials in the Subsurface at the Landfill

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

4/10/00 FR fig-6-3.dwg

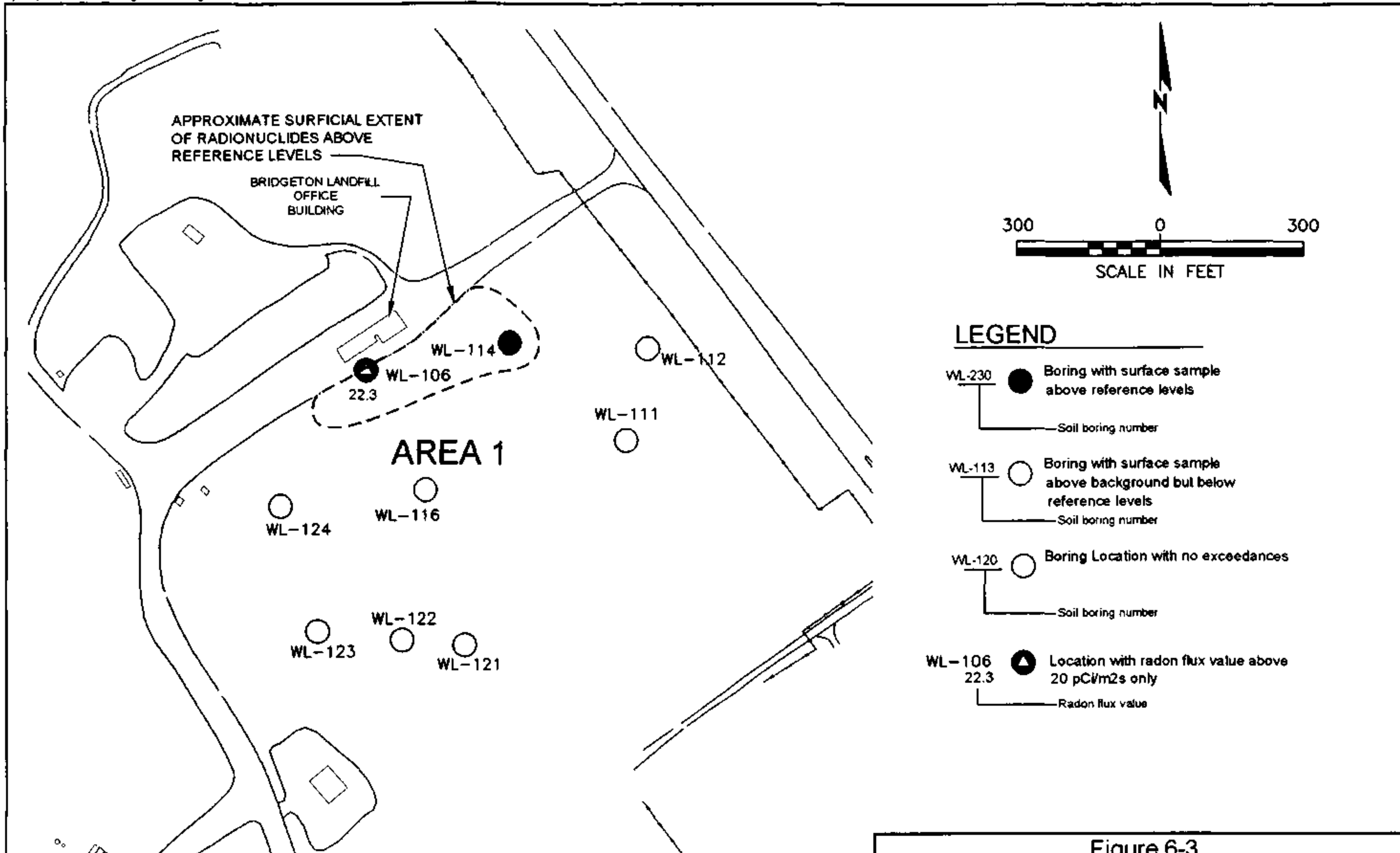


Figure 6-3

Approximate Extent of Radionuclide Impacted Materials at the Surface in Area 1

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

4/10/00 FR fig-6-4.dwg

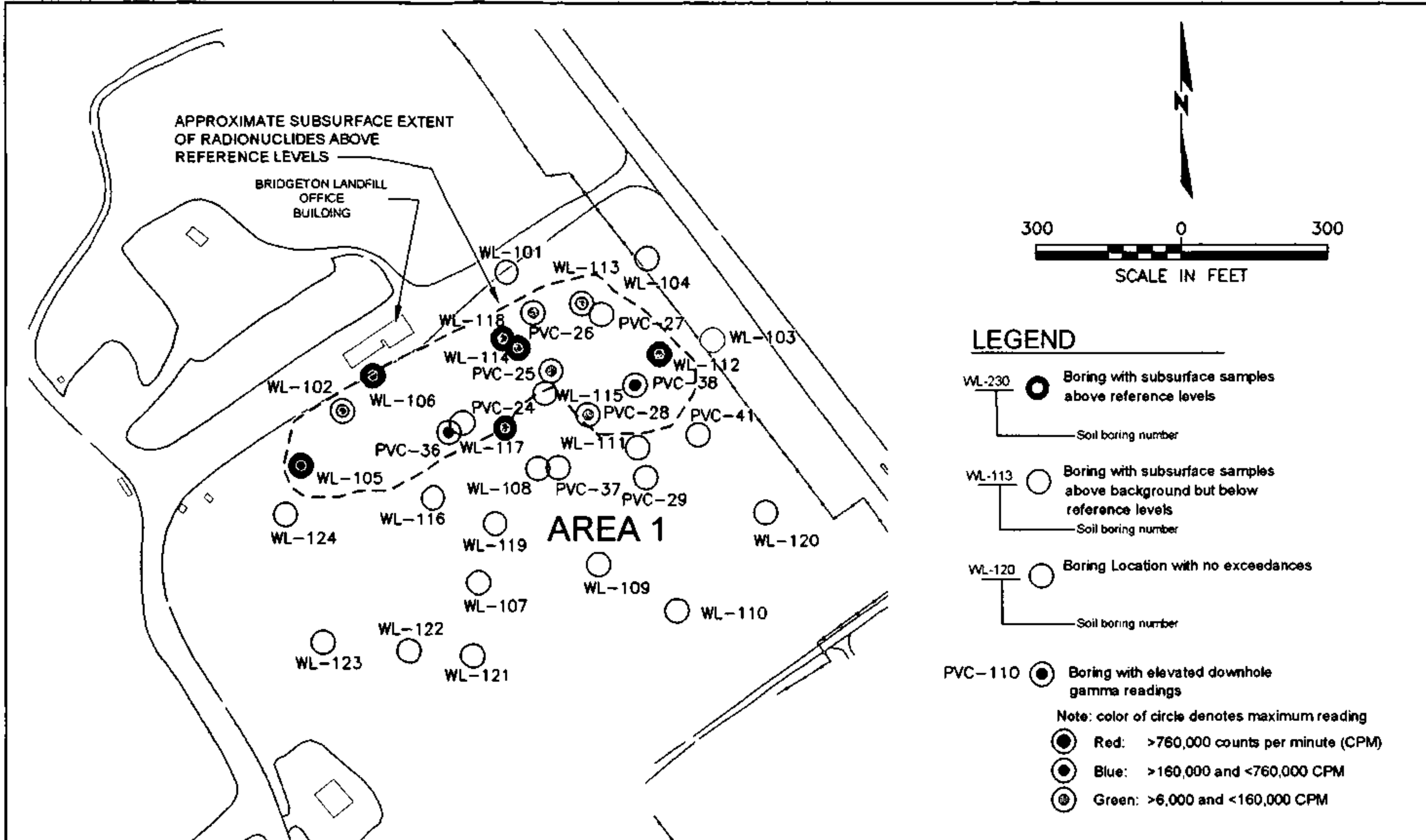


Figure 6-4

Approximate Extent of Radionuclide Impacted Materials in the Subsurface in Area 1

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

4/10/00 FR fig-6-5.dwg

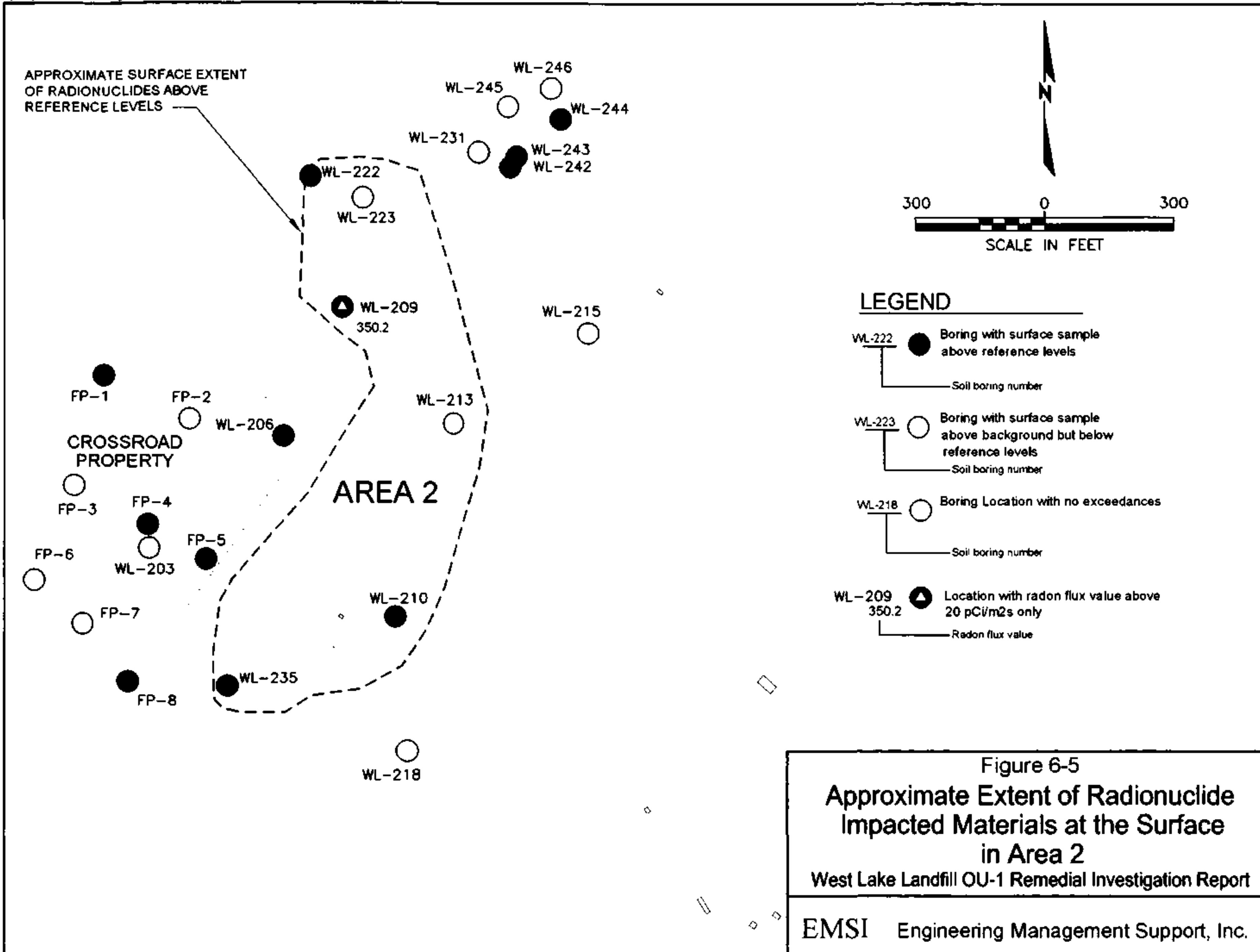


Figure 6-5

Approximate Extent of Radionuclide Impacted Materials at the Surface in Area 2

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

4/10/00 FR fig-6-6.dwg

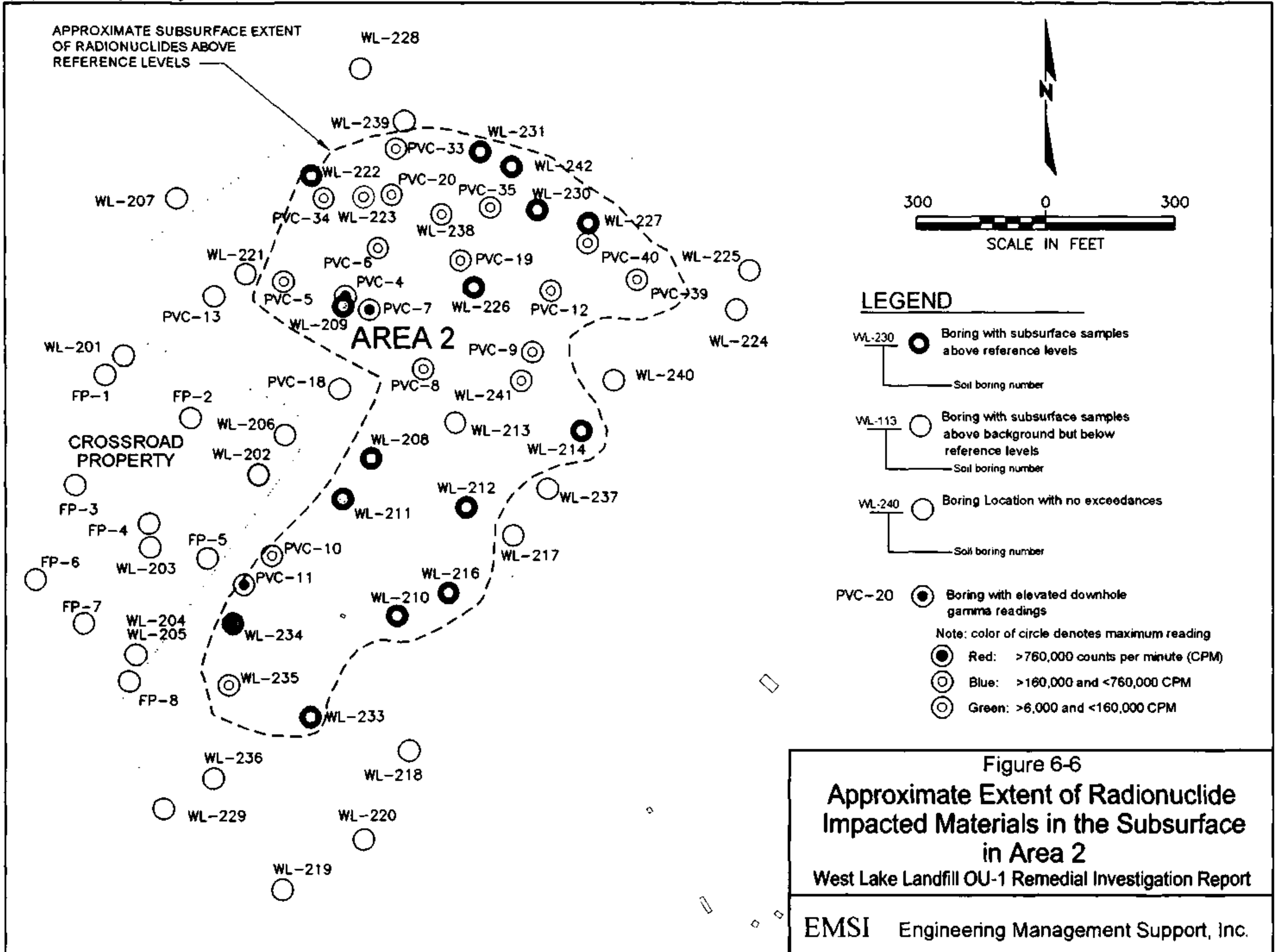


Figure 6-6

Approximate Extent of Radionuclide Impacted Materials in the Subsurface in Area 2

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

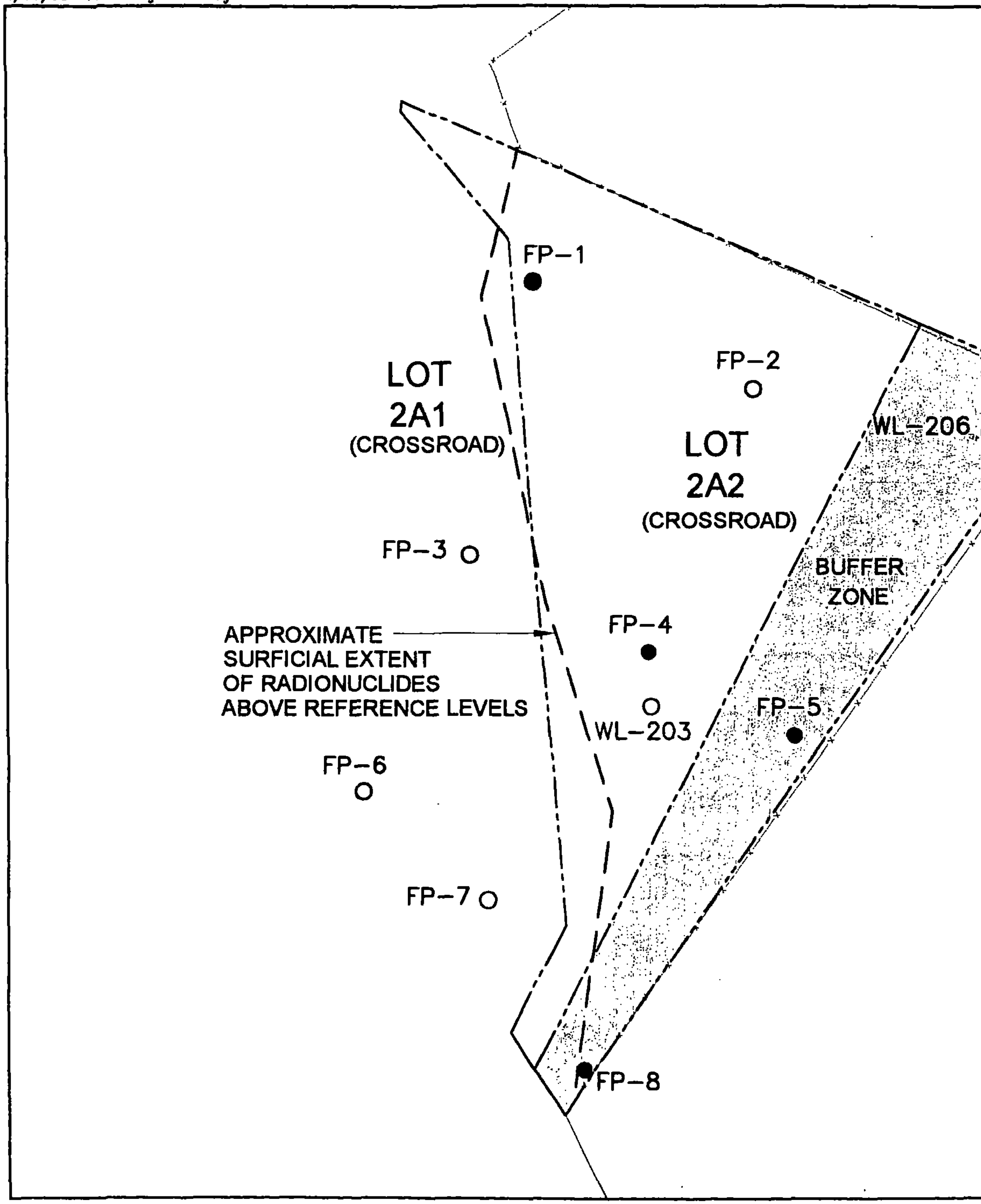


Figure 6-7

Approximate Extent of Radionuclide Impacted Materials in Surface Soil in the Buffer Zone an Crossroad Properties

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

4/10/00 FR fig-6-8.dwg

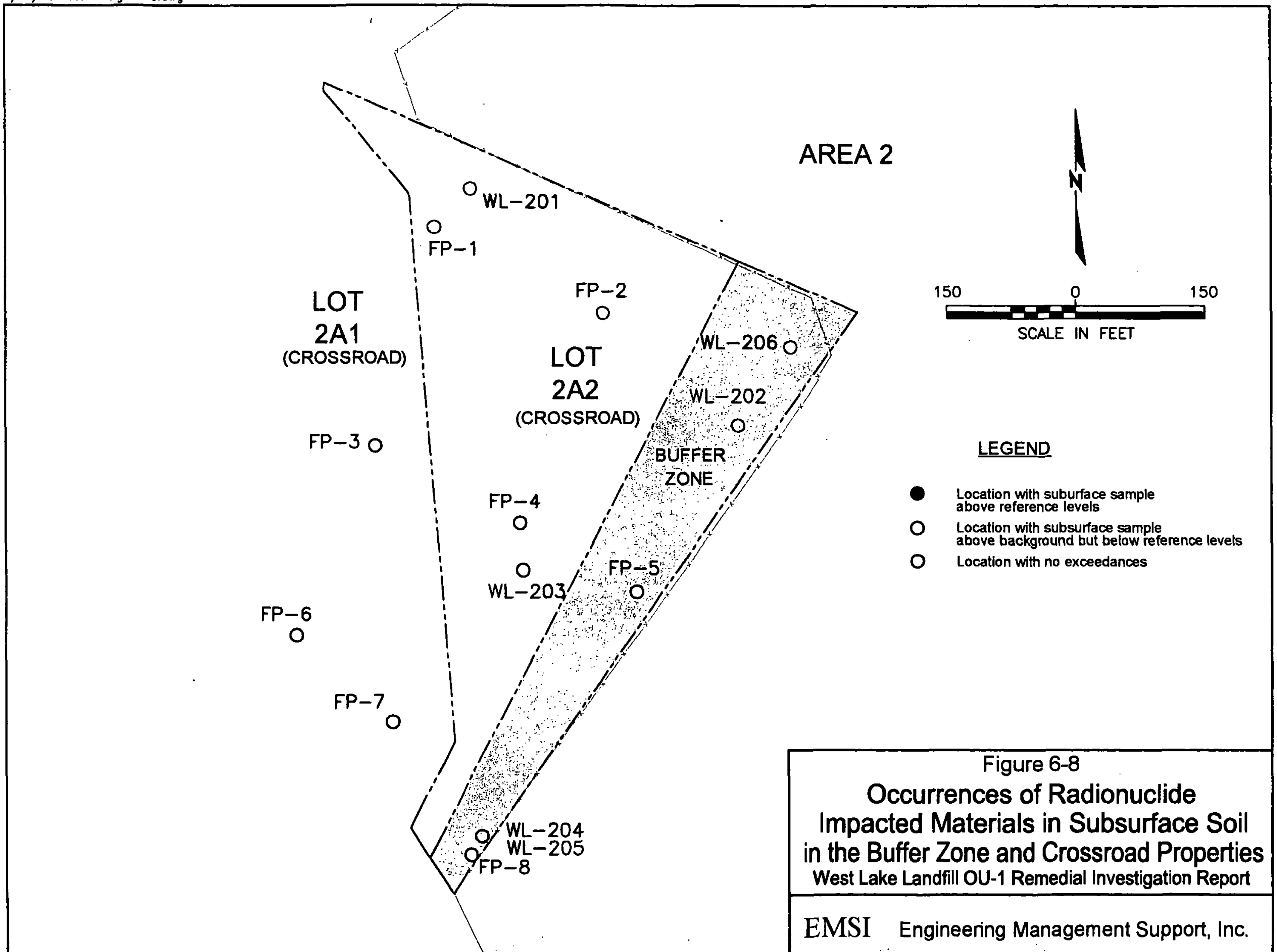


Figure 6-8

Occurrences of Radionuclide Impacted Materials in Subsurface Soil in the Buffer Zone and Crossroad Properties

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

4/6/00 FIG-6-9

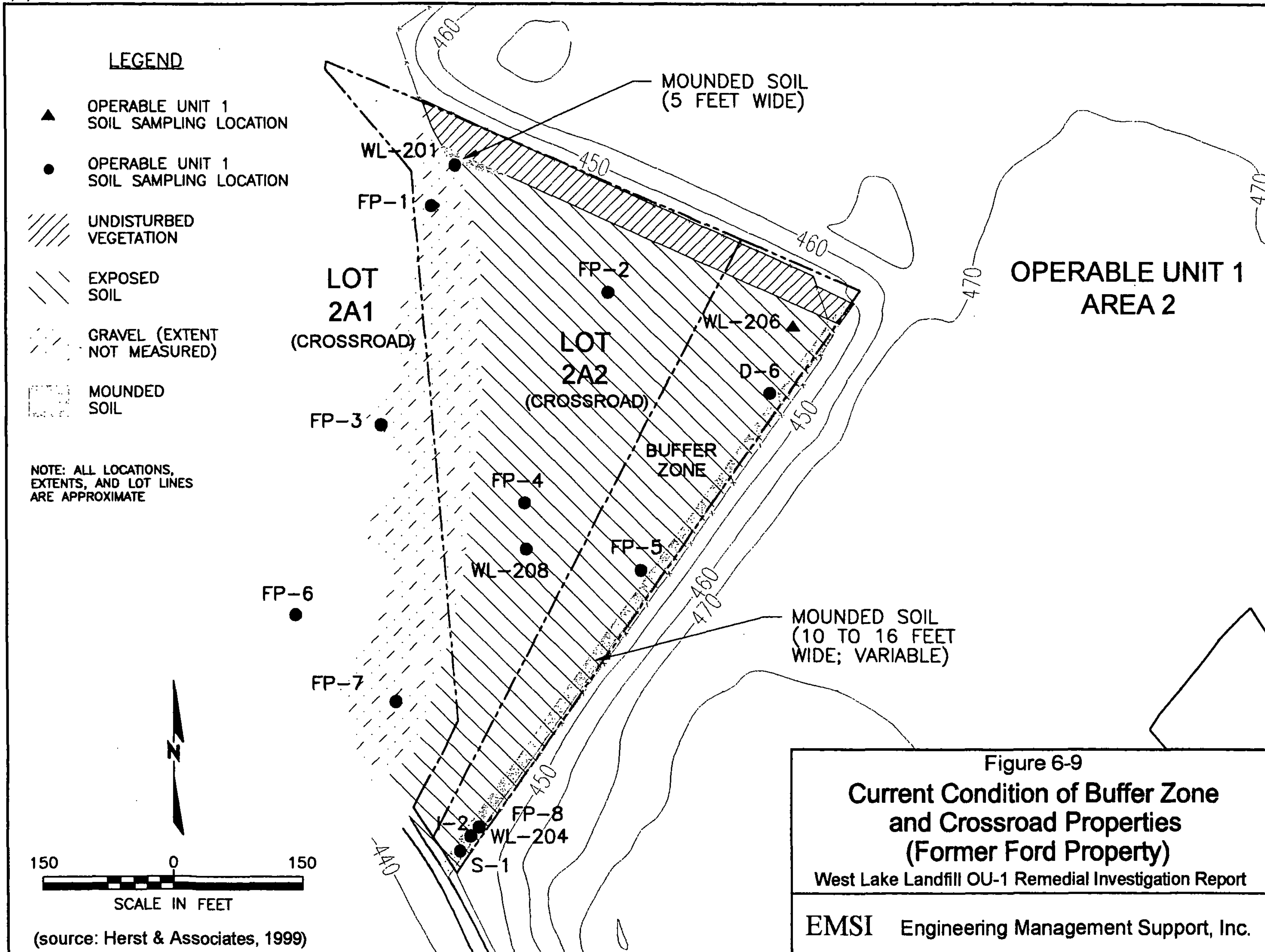


Figure 6-9
Current Condition of Buffer Zone and Crossroad Properties (Former Ford Property)
West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

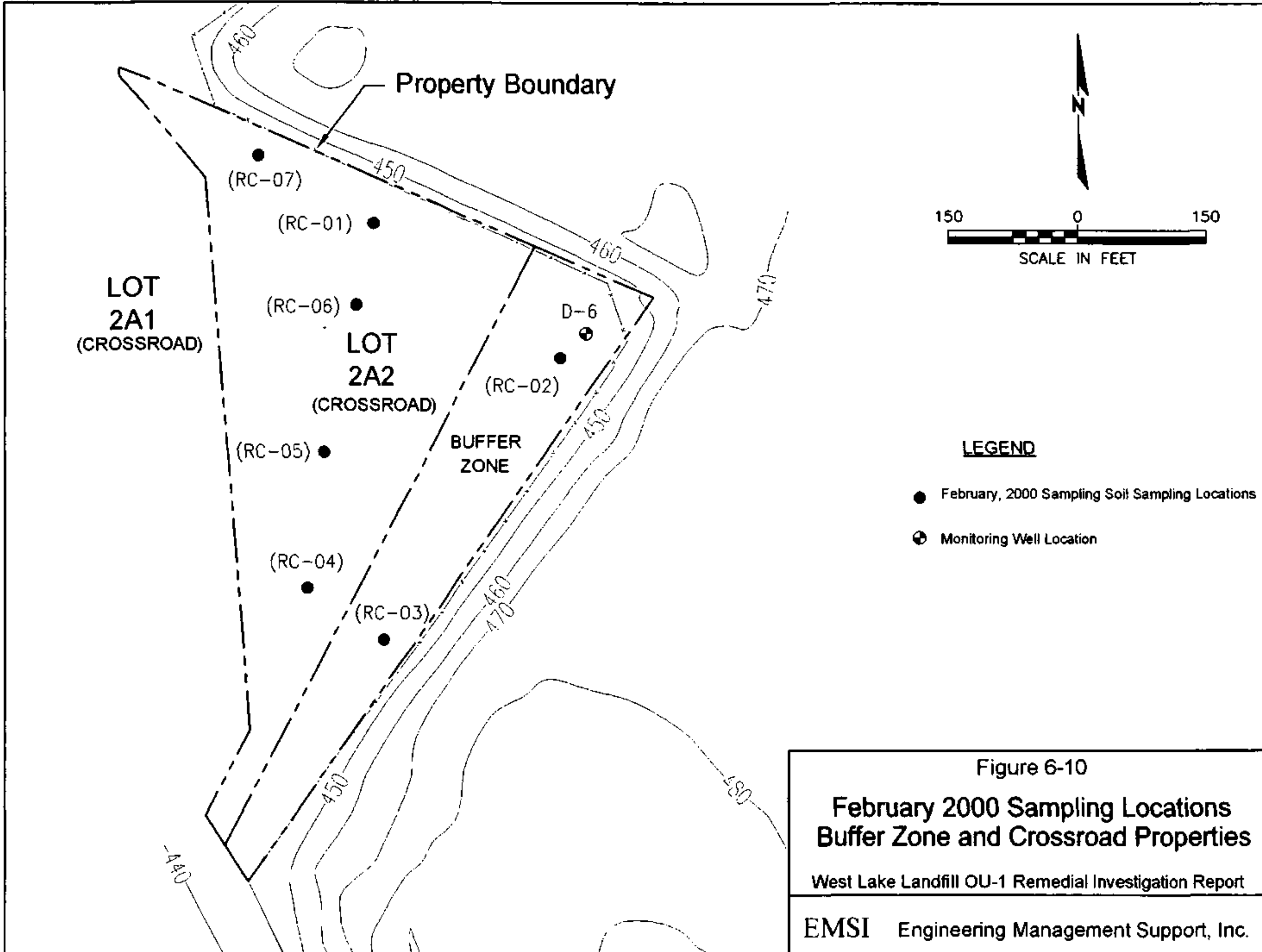
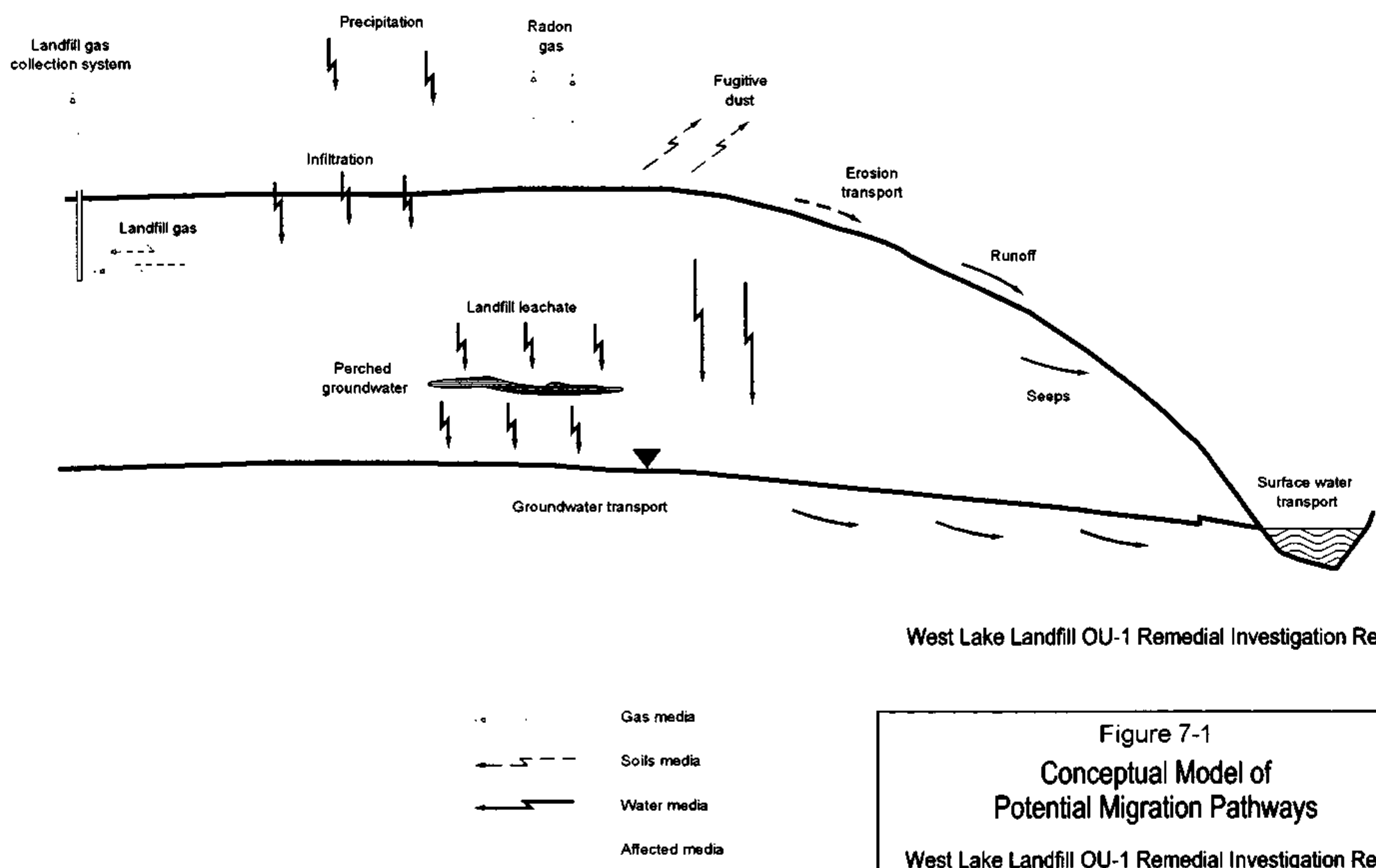


Figure 6-10

February 2000 Sampling Locations Buffer Zone and Crossroad Properties

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

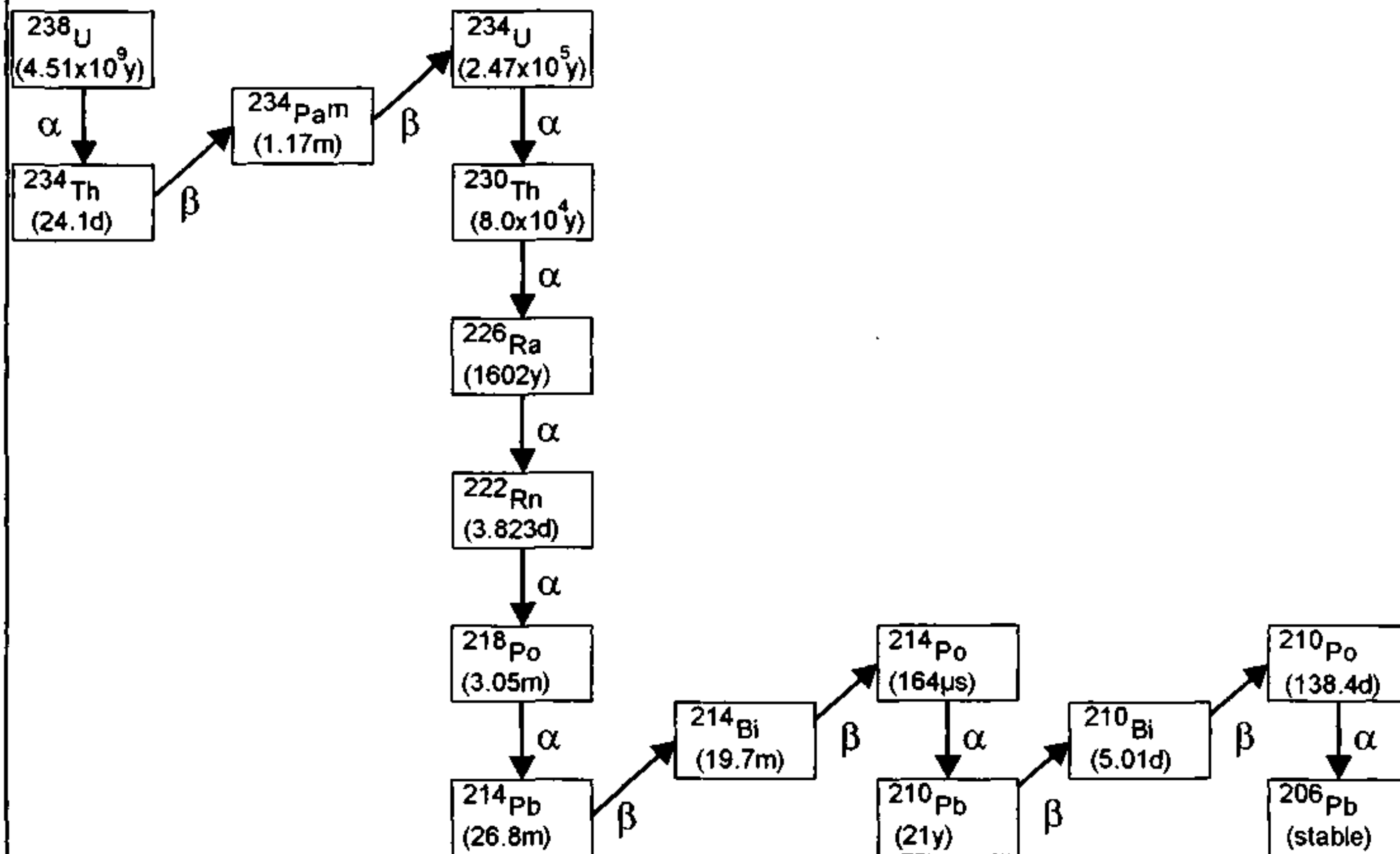


West Lake Landfill OU-1 Remedial Investigation Report

Figure 7-1
Conceptual Model of
Potential Migration Pathways

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.



Legend

^{238}U (4.51×10^9y)	=	Radionuclide Half-Life

Note:
Analytical Results
Obtained for
Highlighted Radionuclides

Note:
Radionuclides produced in less than one percent
of the transformations of the parent are not shown.

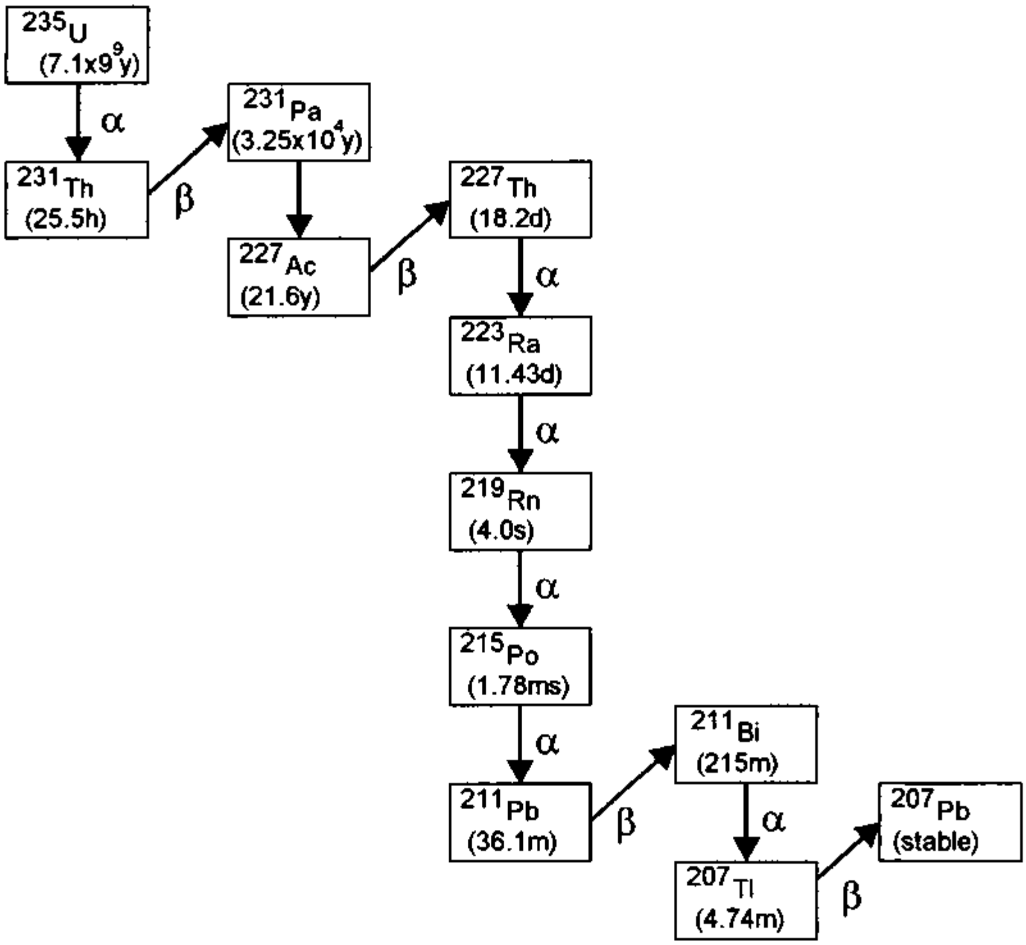
Figure 7-2

Uranium-238 Radioactive Decay Series

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/16/00 FR fig-7-2.dwg



Legend

^{235}U ($7.1x9^9y$)	=	Radionuclide Half-Life

Note:
Analytical Results
Obtained for
Highlighted Radionuclides

Note:
Radionuclides produced in less than one percent
of the transformations of the parent are not shown.

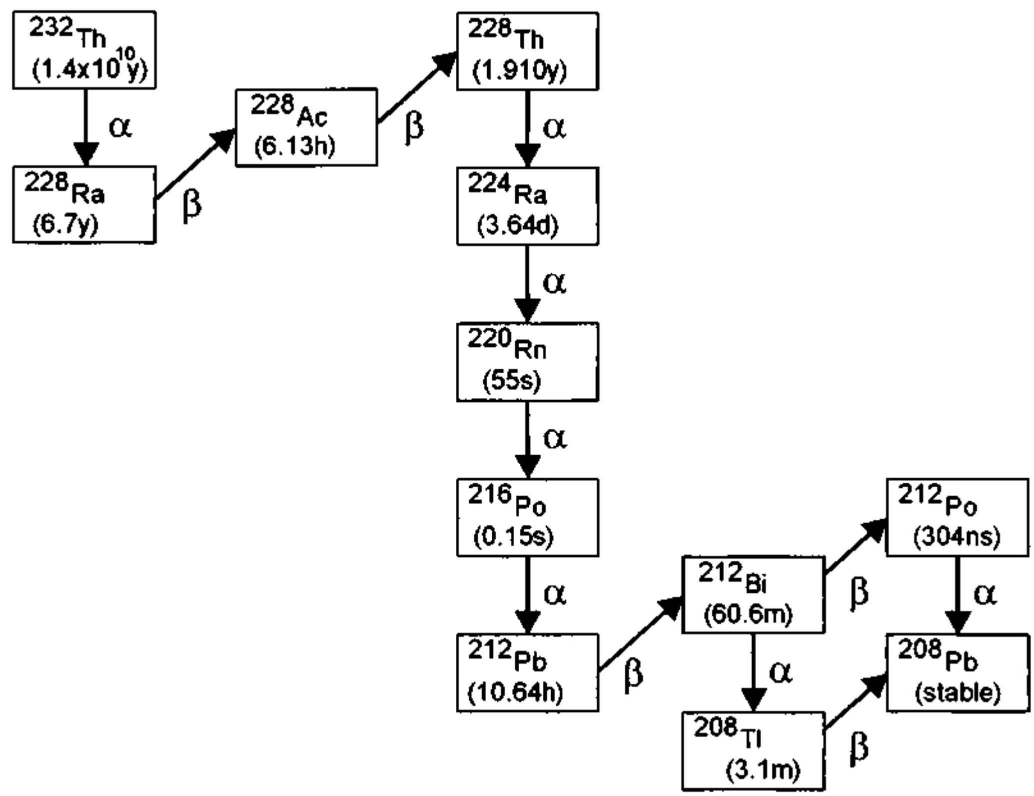
Figure 7-3

Uranium-235 Radioactive Decay Series

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

3/16/00 FR fig-7-3.dwg



Legend

^{232}Th (1.4×10^{10}y)	=	Radionuclide Half-Life

Note:
Analytical Results
Obtained for
Highlighted Radionuclides

Note:
Radionuclides produced in less than one percent of the transformations of the parent are not shown.

fig-7-4.dwg FR 3/16/00

Figure 7-4

Thorium-232 Radioactive Decay Series

West Lake Landfill OU-1 Remedial Investigation Report

EMSI Engineering Management Support, Inc.

Appendix A :

Baseline Risk Assessment

The Baseline Risk Assessment (Appendix A)
is a separate volume that will be submitted under separate cover.

Appendix B :

Radiological and Non-Radiological Analytical Results For Soil Samples

Auger Hole NaI Counts and IG Analysis

Table 5

Borehole #1

Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
				Radionuclide Concentrations (pCi/g)					
00	>50,000	1.6E1	1.6E2	1.7E2	1.6E2	------	------	------	-------
01	>50,000	7.5E2	6.5E2	9E2	1.7E2	------	------	1.4E2	-------
02	>50,000	2.2E4	2.4E4	1.9E4	------	------	------	4.2E3	-------
03	>50,000	4.0E3	3.0E3	4.8E3	------	1.1E3	------	2.1E2	-------
04	>50,000	1.3E3	1.2E3	1.4E3	9.3E1	------	------	------	-------
05	20,000	2.4E1	-------	2.4E1	------	------	8.0E0	------	-------
06	4,500	3.9E0	3.5E0	4.3E0	------	------	1.1E1	------	-------
08	2,200	2.3E0	2.3E0	2.2E0	------	------	1.4E1	------	7.2E-1
10	2,000	2.3E0	2.4E0	2.2E0	------	------	1.3E1	------	8.3E-1
12	1,500	1.9E0	2.2E0	1.6E0	------	------	1.3E1	------	-------
14	1,300	1.8E0	1.9E0	1.7E0	------	------	9.7E0	------	6.3E-1
16	800	1.3E0	1.2E0	1.3E0	------	------	1.0E1	------	3.9E-1
18	800	1.2E0	1.6E0	8.0E-1	------	------	3.3E0	------	3.0E-1
20	800	8.1E-1	7.4E-2	8.7E-1	------	------	1.0E1	------	3.2E-1
22	500	6.5E-1	4.0E-1	9.0E-1	------	------	2.5E0	------	-------
24	150	2.5E-1	2.8E-1	2.1E-1	------	------	1.5E0	------	-------
26	1,000	6.3E-1	7.2E-1	5.4E-1	------	------	6.3E0	------	3.1E-1
28	1,300	8.7E-1	8.4E-1	8.9E-1	------	------	1.2E1	------	5.7E-1
30	500	4.3E-1	-------	4.3E-1	------	------	3.0E0	------	2.1E-1
32	700	1.3E0	1.E0	1.2E0	------	------	6.1E0	------	4.2E-1
34	1,400	2.4E0	2.5E0	2.2E0	------	------	6.1E0	------	5.4E-1
36	1,800	1.4E0	1.5E0	1.2E0	------	------	1.2E1	------	-------

Borehole #3

Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
				Radionuclide Concentrations (pCi/g)					
00	>50,000	8.4E2	7.8E2	8.4E2	------	------	------	6.4E1	-------
01	>50,000	1.5E4	1.3E4	1.9E4	1.4E3	------	------	------	-------
2	>50,000	7.0E3	5.3E3	8.7E3	------	------	------	------	-------
3	1,400	2.3E1	1.4E1	3.2E1	------	------	1.2E1	------	-------
05	2,300	6.2E0	5.8E0	6.6E0	------	------	8.9E0	------	-------
07	3,000	4.7E0	4.9E0	4.4E0	------	------	6.9E0	------	-------
09	1,800	3.5E0	4.2E0	2.8E0	------	3.6E0	8.2E0	------	-------
11	1,000	1.8E0	2.1E0	1.5E0	------	------	4.1E0	------	-------
13	600	1.7E0	1.4E0	2.0E0	------	------	------	------	-------
15	1,800	4.5E0	4.6E0	4.4E0	------	4.7E0	4.2E0	------	-------

Table 5, cont.

Borehole #3, cont.

Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
				Radionuclide Concentrations (pCi/g)					
17	1,000	9.0E-1	1.1E0	7.3E-1	------	------	6.4E0	------	4.4E-1
19	500	2.9E-1	3.E-1	2.1E-1	------	------	2.2E0	------	-------
21	500	5.0E-1	7.E-1	2.2E-1	------	------	2.0E0	------	-------
23	700	1.0E0	1.1E0	8.7E-1	------	------	6.3E0	------	5.3E-1
25	600	3.3E-1	3.7E-1	2.9E-1	------	------	------	------	-------
27	900	9.7E-1	1.1E0	8.4E-1	------	------	6.5E0	------	5.4E-1
29	1,000	5.4E-1	4.8E-1	6.0E-1	------	------	7.6E0	------	-------

Borehole #4

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
				Radionuclide Concentrations (pCi/g)					
00	>50,000	------	1.5E2	1.7E2	1.3E2	9.5E1	------	9.9E1	-------
01	>50,000	5.3E2	2.1E3	1.7E3	2.5E3	9.8E2	------	1.2E3	-------
02	>50,000	------	1.2E2	9.E1	1.5E2	------	3.6E0	------	-------
03	14,000	------	2.8E0	2.1E0	[illegible].5E0	------	3.8E0	------	-------
04	2,900	------	1.6E0	1.6E0	1.6E0	------	3.6E0	------	-------
06	1,100	------	1.4E0	1.5E0	1.2E0	8.6E-1	4.1E0	------	-------
08	1,200	------	1.7E0	1.9E0	1.5E0	9.0E-1	7.1E0	------	-------
10	1,500	------	2.7E	2.8E0	2.5E0	8.3E-1	9.3E0	3.8E0	-------
12	2,600	------	-------	------	------	------	------	------	-------
14	1,500	------	1.7E0	1.6E0	1.7E0	7.0E-1	7.0E0	------	-------
16	1,400	------	1.0E0	1.2E0	8.4E-1	------	------	------	-------
18	1,100	------	8.0E-1	8.E1-1	6.0E-1	------	8.5E0	------	3.8E-1
20	800	------	7.6E-1	8.6E-1	6.6E-1	------	------	------	-------
22	1,100	------	1.1E0	.1E0	1.1E0	------	7.7E0	------	4.1E1
24	1,200	------	7.5E-1	8.1E-1	7.0E-1	------	1.6E-1	------	3.5E-1
26	1,000	------	4.8E-1	4.2E-1	5.4E-1	------	6.6E0	------	3.0E-1
28	700	------	7.1E-1	7.2E-1	7.0E-1	------	------	------	-------
30	1,300	------	8.7E-1	9.9E-1	7.5E-1	------	1.4E1	------	6.4E-1
32	1,500	------	9.5E-1	9.5E-1	9.5E-1	------	1.5E1	------	-------
34	1,700	------	1.9E0	2.2E0	1.6E0	------	1.3E1	------	5.5E-1

Borehole #5

Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
				Radionuclide Concentrations (pCi/g)					
00	1,800	1.8E0	-------	1.7E0	------	------	6.3E0	------	-------
02	1,500	2.5E0	2.9E0	2.0E0	------	3.4E0	4.0E0	------	-------
04	2,700	3.4E0	3.7E0	3.1E0	------	------	4.4E0	------	-------
06	1,600	1.7E0	1.5E0	1.9E0	------	------	1.1E1	------	9.2E-1

Table 5, cont.

Porehole #5, cont.				Radionuclide Concentrations (pCi/g)					
Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
08	1,000	1.3E0	1.6E0	1.0E0	------	------	1.0E1	------	-------
10	3,000	4.3E0	4.3E0	4.3E0	------	------	4.7E0	------	2.[illegible]E0
12	1,700	2.1E0	1.9E0	2.3E0	------	------	2.9E0	2.2E0	-------
14	1,000	1.8E0	1.3E0	2.[illegible]E0	------	------	3.0E0	------	-------
16	700	8.3E-1	6.0E-1	1.1E0	------	------	2.1E0	------	-------
18	500	8.9E-1	6.8E-1	1.1E0	------	------	2.1E0	------	-------

Borehole #6				Radionuclide Concentrations (pCi/g)					
Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	2,000	------	7.3E0	8.3E0	6.4E0	7.4E0	9.4E0	1.2E1	-------
02	2,000	------	-------	------	------	------	------	------	-------
04	3,200	2.2E1	2.5E0	3.0E1	.0E1	2.0E1	------	1.9E1	-------
06	3,500	------	2.1E0	2.2E1	2.1E1	1.9E1	------	1.6E1	-------
07	6,000	1.6E1	1.5E1	1.7E1	1.3E1	8.1E0	------	------	-------
08	26,000	3.9E1	2.1E1	2.2E1	2.1E1	1.8E1	------	1.5E1	-------
09	>50,000	------	4.0E1	4.1E1	4.0E1	3.6E1	------	------	-------
10	43,000	------	5.8E1	5.3E1	6.3E1	4.1E1	------	4.01E	-------
11	>50,000	------	3.6E2	2.8E2	2.3E2	2.0E2	------	1.7E2	-------
12	16,000	4.4E1	9.9E1	9.1E1	1.1E2	3.9E1	------	5.6E1	-------
13	2,600	------	6.4E0	7.2E0	5.5E0	4.4E0	8.5E0	------	-------
15	1,100	------	-------	------	------	------	------	------	-------

Borehole #8				Radionuclide Concentrations (pCi/g)					
Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	2,000	------	3.7E0	4.0E0	3.4E0	1.5E0	5.2E0	------	4.9E-1
02	1,500	------	1.4E0	1.5E0	1.3E0	------	6.5E0	------	-------
04	1,100	------	1.1E0	1.2E0	9.2E-1	------	4.7E0	------	-------
06	1,400	------	1.1E0	1.1E0	1.1E0	------	1.1E1	------	8.3E-1
08	1,400	------	1.1E0	1.1E0	1.1E0	------	1.1E1	------	8.E-1
10	1,500	------	1.2E0	1.2E0	1.1E0	------	1.1E1	------	-------
12	1,400	------	1,2E0	1.1E0	1.3E0	------	1.3E1	------	[illegible].E-1
14	1,600	------	1.1E0	1.1E0	1.1E0	------	1.5E1	------	-------
16	1,000	------	1.1E0	1.3E0	8.2E-1	------	1.1E1		
18	1,400	------	1.[illegible]E0	[illegible]					

Table 5, cont.

Borehole #9

Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	1,400	------	2.2E0	2.3E0	2.0E0	------	------	------	3.2E-1
02	22,000	4.6E1	5.6E1	5.6E1	5.5E1	3.5E1	1.1E1	3.1E1	-------
03	11,000	------	5.4E0	4.2E0	6.5E0	------	1.2E1	------	-------
04	2,000	------	1.3E0	1.3E0	1.4E0	------	9.3E0	------	-------
06	600	------	7.0E-1	8.4E-1	5.6E-1	------	3.8E0	------	-------
08	1,000	------	9.8E-1	7.8E-1	1.2E0	------	6.1E0	------	-------
10	900	------	8.0E-1	9.5E-1	6.5E-1	------	5.E0	1.6E0	-------
12	1,000	------	1.1E0	1.3E0	1.0E0	------	8.1E0	------	3.4E-1
14	700	2.7E0	7.7E1	8.3E-1	7.0E-1	------	4.9E0	------	5.0E-1
16	1,100	------	1.0E0	1.0E0	1.0E0	------	------	------	4.7E-1
18	1,300	------	-------	------	------	------	------	------	-------
20	1,000	7.6E-1	1.1E0	1.2E0	9.8E-1	------	8.7E0	------	-------
22	1,200	------	1.3E0	1.3E0	1.2E	------	9.5E0	------	5.3E-1

Borehole #10

Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	7,000	------	3.5E0	3.3E0	3.7E0	9.4E-1	3.6E0	------	-------
01	35,000	------	1.4E1	9.2E0	1.8E1	4.4E0	3.6E0	------	-------
02	>50,000	------	4.2E2	3.7E2	4.8E2	------	------	------	-------
03	>50,000	------	4.8E2	4.4E2	5.2E2	------	------	------	-------
04	35,000	------	2.5E1	1.8E1	3.E1	------	------	------	-------
05	13,000	------	9.4E0	8.3E0	1.E1	------	------	------	-------
06	4,500	------	1.2E1	1.4E1	1.0E1	3.9E0	------	5.0E0	3.1E-1
08	2,000	------	1.3E1	1.1E1	1.5E1	------	------	------	2.4E-1
10	1,800	7.3E1	1.2E2	1.3E2	1.0E2	7.0E1	------	4.5E1	-------
12	2,000	1.2E1	1.6E1	1.8E1	1.3E1	1.1E1	4.2E0	1.1E1	-------
14	500	4.9E0	5.1E0	6.1E0	4.0E0	2.7E0	3.0E0	------	-------

Borehole #11

Radionuclide Concentrations [pCi/g]

Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
00	>50,000	8.4E1	6.6E1	1.0E2	------	2.2E1	5.6E0	------	-------
01	>50,000	3.6E3	2.9E3	4.4E3	7.7E2	------	------	------	-------
02	>50,000	1.3E4	-------	1.3E4	2.9E3	------	------	------	-------
03	>50,000	1.7E3	1.1E3	.2E3	------	------	------	------	-------
04	30,000	7.0E0	5.3E0	8.6E0	------	------	------	------	-------
05	22,000	4.9E0	4.6E0	5.2E0	------	3.6E0	1.3E1	7.1E0	7.4E0

Borehole #11, cont.

Radionuclide Concentrations (pCi/g)

Depth	Gross NaI	Ra-226	Pb-214	Bi-214	U-238	Ra-223	K-40	Pb-211	Pb-212
06	20,000	7.1E0	7.4E0	6.7E0	------	4.6E0	1.5E1	------	
07	20,000	8.3E0	8.8E0	7.8E0	------	------	1.1E1	------	
08	20,000	1.3E1	1.5E1	1.2E1	------	2.0E1	1.0E1	5.8E0	-------
09	20,000	------	-------	------	------	------	------	------	-------

Borehole #16

Radionuclide Concentrations (pCi/g)

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
02	6,000	1.3E1	1.4E1	1.6E1	1.1E1	4.3E0	6.2E0	6.1E0	-------
03	9,000	------	1.8E1	2.2E1	1.5E1	6.9E0	7.9E0	8.8E0	-------
04	33,000	2.8E1	5.0E1	5.9E1	4.2E1	2.0E1	5.0E0	1.6E1	-------
05	48,000	6.5E1	1.1E2	1.3E2	9.8E1	5.6E1	1.0E1	3.7E1	-------
06	35,000	------	1.2E2	1.4E2	1.0E2	7.8E1	6.7E0	4.3E1	-------
07	9,000	------	4.8E1	5.5E1	3.1E1	3.1E1	------	2.0E1	8.2E-1
08	6,000	1.2E1	1.4E1	1.5E1	1.2E1	4.8E0	3.7E0	------	-------
09	15,000	------	1.5E1	1.7E1	1.3E1	7.0E0	4.1E0	5.5E0	-------
10	35,000	------	5.8E1	6.6E1	5.0E1	7.5E1	2.3E0	2.5E1	-------
11	>50,000	1.7E2	3.8E2	4.5E2	3.1E2	1.7E2	------	1.4E2	8.5E-1
12	>50,000	1.9E2	5.1E2	6.0E2	4.8E2	3.0E2	------	1.4E2	2.8E0
13	>50,000	1.2E2	2.4E2	2.4E2	2.4E2	7.2E1	------	2.6E1	-------
14	>50,000	3.3E2	5.4E2	4.7E2	6.0E	2.4E2	------	4.0E2	-------
15	>50,000	------	9.2E3	6.9E3	1.1E4	------	------	------	-------
16	>50,000	------	7.7E3	6.1E3	9.2E3	------	------	------	-------
17	37,000	------	8.2E1	8.1E1	8.3E1	1.6E1	5.7E0	2.6E1	-------
18	8,000	------	2.9E1	3.0E1	2.7E1	6.1E0	------	1.5E1	-------
19	6,000	1.3E1	3.4E1	4.2E1	2.6E1	1.5E2	------	1.9E1	-------

Borehole #17

Radionuclide Concentrations (pCi/g)

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
00	700	------	1.2E0	1.1E0	1.2E0	------	4.4E0	------	-------
02	600	------	5.4E-1	5.3E-1	5.4E-1	------	2.3E0	------	1.3E-1
04	300	------	3.3E-1	3.7E-1	2.9E-1	------	1.8E0	------	1.8E-1
06	250	------	2.6E-1	2.4E-1	2.7E-1	------	1.9E0	------	-------
08	300	------	2.4E-1	2.9E-1	1.9E-1	------	------	------	-------
10	300	------	2.9E-1	3.6E-1	2.2E-1	------	2.0E0	------	-------
12	400	------	2.7E-1	------	2.7E-1	------	3.0E0	------	2.1E-1
14	700	------	5.9E-1	5.3E-1	6.5E-1	------	4.7E0	------	6.5E-1

Table 5, cont.

Borehole #17, cont.

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
				Radionuclide Concentrations (pCi/g)					
16	1,500	------	1.2E0	------	1.2E0	------	1.E1	------	-------
18	800	------	1.5E0	1.5E0	1.4E0	------	5.3E0	------	-------
20	3,000	------	8.5E0	9.0E0	8.0E0	2.9E0	6.5E0	------	-------
22	1,000	------	1.6E0	1.7E0	1.5E0	------	4.3E0	------	-------

Borehole #18

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
				Radionuclide Concentrations (pCi/g)					
00	1,000	------	-------	------	------	------	------	------	-------
02	1,500	------	1.3E0	1.3E0	1.2E0	7.2E-1	7.8E0	------	-------
04	1,100	------	9.3E-1	1.0E0	8.3E-1	------	------	------	-------
06	1,000	------	9.9E-1	1.1E0	8.8E-1	------	6.90E	------	-------
08	600	------	4.1E-1	3.3E-1	4.8E-1	------	2.5E0	------	-------
10	600	------	5.7E-1	6.5E-1	4.9E-1	------	2.5E0	------	-------
12	1,100	------	7.7E-1	9.4E-1	6.1E-1	------	------	------	-------
14	1,000	------	6.7E-1	7.2E-1	6.1E-1	------	------	------	-------
16	1,000	------	7.6E-1	1.0E0	5.0E-1	------	------	------	4.8E-1
18	1,200	------	-------	------	------	------	------	------	-------

Borehole #19

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
				Radionuclide Concentrations (pCi/g)					
00	1,000	------	1.3E0	1.4E0	1.3E0	------	1.6E0	------	-------
02	1,700	------	3.9E0	4.3E0	3.4E0	2.1E0	4.4E0	------	4.1E-1
04	2,100	------	3.9E0	4.2E0	3.5E0	------	1.4E1	------	8.1E-1
06	4,400	------	6.0E0	6.3E0	5.8E0	2.3E0	1.0E1	------	8.6E-1
07	28,000	3.3E1	3.7E1	3.5E1	3.9E1	2.2E1	1.3E1	2.5E1	-------
08	>50,000	4.2E1	3.4E2	3.4E2	3.4E2	2.3E2	7.5E0	2.3E2	-------
09	17,000	2.7E1	1.9E1	1.7E1	2.2E1	5.3E0	------	1.3E1	-------
10	4,600	------	1.2E0	3.9E0	4.4E0	------	6.1E0	------	-------
12	1,000	------	6.5E-1	6.0E-1	7.0E-1	------	4.9E0	------	-------
14	600	------	8.6E-1	1.1E0	6.4E-1	------	------	------	2.1E-1
16	500	------	6.4E-1	7.1E-1	5.7E-1	------	2.4E0	------	-------

Table 5, cont.

Borehole #20				Radionuclide Concentrations (pCi/g)					
Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
-----	-------	------	-------	------	------	------	------	------	-------
00	10,000	------	8.9E0	3.8E0	1.4E1	6.9E0	6.8E0	------	-------
01	23,000	------	7.2E1	6.8E1	7.6E1	4.3E1	1.0E1	3.9E1	-------
02	9,000	------	1.4E1	9.9E0	1.7E1	2.9E0	8.2E0	1.7E1	-------
03	2,200	------	2.7E0	------	2.7E0	------	6.0E0	------	-------
05	900	------	1.3E0	1.4E0	1.1E0	------	------	------	-------
07	700	------	1.2E0	1.2E0	1.1E0	------	9.9E0	------	-------
09	1,000	------	1.5E0	2.0E0	1.0E0	------	1.5E1	------	-------
11	1,600	------	1.9E0	1.9E0	1.8E0	------	2.7E1	------	1.3E0
13	1,200	------	1.2E0	1.3E0	------	------	------	------	1.2E0
15	1,100	------	1.2E0	1.3E0	1.1E0	------	1.8E0	------	6.6E-1
17	500	------	7.0E-1	7.7E-1	6.4E-1	------	------	------	3.6E-1

Borehole #21				Radionuclide Concentrations (pCi/g)					
Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
-----	-------	------	-------	------	------	------	------	------	-------
00	14,000	2.1E1	3.4E1	4.2E1	2.7E1	------	------	------	-------
01	13,000	------	1.3E1	1.3E1	1.2E1	3.2E0	1.8E0	------	-------
02	1,300	------	1.2E0	9.5E-1	1.4E0	------	2.1E0	------	-------
03	1,300	------	1.3E0	1.3E0	1.3E0	------	------	------	-------
04	7,000	------	5.4E0	5.2E0	5.6E0	------	------	------	-------
05	46,000	1.8E1	6.2E1	6.0E1	6.4E1	1.2E1	9.2E0	2.1E1	-------
06	>50,000	1.7E1	6.6E2	5.4E2	7.8E2	------	------	3.3E2	-------
07	>50,000	4.5E2	3.2E3	2.8E3	3.7E3	8.3E2	------	1.5E3	-------
08	>50,000	3.2E1	7.3E1	6.7E1	7.9E1	2.9E1	------	3.2E1	-------
09	32,000	------	3.6E1	3.6E1	3.5E1	9.3E0	8.2E0	1.2E1	-------
10	9,000	------	2.2E1	2.8E1	2.0E1	1.9E0	5.6E0	------	-------
11	4,300	------	1.5E1	1.7E1	1.2E1	------	3.3E0	------	-------
12	6,000	------	5.8E0	6.2E0	5.4E0	------	5.9E0	------	-------
13	7,000	------	8.1E0	8.8E0	7.3E0	3.8E0	1.1E1	------	8.5E-1
14	7,000	------	1.3E1	1.5E1	1.1E1	6.1E0	1.1E1	------	-------
15	10,000	5.6E0	1.1E1	1.3E1	9.4E0	5.3E0	9.4E0	5.1E0	6.7E-1
16	8,000	------	6.5E0	7.2E0	5.7E0	3.2E0	4.4E0	------	-------
17	,000	------	6.1E0	7.1E0	5.2E0	3.7E0	3.1E0	------	-------
18	3,500	5.6E0	5.7E6	6.4E0	4.4E9	2.7E0	3.0E0	------	-------
20	3,000	------	6.9E0	8.3E0	5.5E0	4.4E0	------	------	-------

Table 5, cont.

Borehole #22				Radionuclide Concentrations (pCi/g)					
Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
-----	-------	------	-------	------	------	------	-------	------	-------
00	10,000	------	2.4E1	2.7E1	2.1E1	1.6E1	2.7E0	------	-------
01	13,000	2.0E1	3.2E1	3.8E1	2.5E1	1.5E1	5.9E0	1.7E1	5.6E-1
02	11,000	1.9E1	2.8E1	3.2E1	2.5E1	1.6E1	4.1E0	1.5E1	-------
03	4,300	------	5.6E0	6.3E0	4.9E0	2.2E0	4.1E0	------	6.7E-1
04	5,500	------	1.1E1	1.2E1	8.8E0	5.9E0	6.5E0	------	-------
06	4,500	------	8.1E0	9.4E0	6.7E0	5.4E0	3.8E0	5.7E0	3.6E-1
07	5,000	9.4E0	8.9E0	1.0E1	7.3E0	5.4E0	6.3E0	------	7.0E-1
08	5,000	1.0E1	1.0E1	1.3E1	8.4E0	7.1E0	3.7E0	6.6E0	-------
10	4,300	------	1.5E1	1.8E1	1.2E1	7.3E0	2.8E0	5.E0	-------
12	7,000	------	1.4E1	1.7E1	1.1E1	------	4.1E0	------	-------
13	4,000	1.5E1	1.4E1	1.6E1	1.1E1	6.9E0	2.9E0	6.1E0	-------
14	7,000	9.1E0	1.3E1	1.6E1	1.1E1	4.7E0	4.8E0	------	-------
15	9,000	------	2.3E1	2.9E1	1.7E1	1.3E1	3.7E0	1.0E1	-------
16	8,000	------	2.3E1	2.8E1	1.9E1	1.6E1	2.0E0	1.1E1	-------
17	3,500	7.3E0	7.4E0	8.3E0	6.4E0	5.0E0	2.3E0	------	-------
18	7,000	1.8E1	1.8E1	2.0E1	1.5E1	6.1E0	------	------	-------
19	9,000	------	1.7E1	2.0E1	1.4E1	1.2E1	3.8E0	------	-------
20	13,000	------	3.5E1	4.0E1	3.0E1	2.5E1	3.7E0	1.5E1	-------
21	10,000	------	1.1E1	1.1E1	1.1E1	3.5E0	3.6E0	------	-------
22	24,000	------	1.9E1	1.6E1	2.1E1	4.1E0	4.3E0	6.3E0	-------
23	>50,000	------	5.8E3	5.8E3	5.8E3	3.0E2	------	2.6E2	-------
24	>50,000	------	7.0E2	6.4E2	7.5E2	2.9E2	------	3.3E2	-------
25	>50,000	------	6.4E2	6.4E2	6.4E2	3.6E2	------	3.4E2	-------

Borehole #31				Radionuclide Concentrations (pCi/g)					
Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
-----	-------	------	-------	------	------	------	------	------	-------
00	1,200	------	6.5E-1	5.6E-1	7.4E-1	------	7.8E0	------	5.6E-1
02	900	------	5.6E-1	5.9E-1	5.3E-1	------	------	------	4.5E-1
04	1,500	------	9.1E-1	9.3E-1	8.9E-1	------	6.5E0	1.7E0	-------
06	1,000	------	6.3E-1	6.4E-1	6.3E-1	------	6.1E0	------	-------
08	800	------	5.1E-1	4.5E-1	5.7E-1	------	------	------	-------
10	800	------	4.9E-1	5.2E-1	4.5E-1	------	------	------	3.8E-1
12	1,500	------	3.7E-1	3.7E-1	------	------	3.7E0	------	-------
14	1,100	------	7.1E-1	------	7.1E-1	------	1.3E1	------	-------
16	1,000	------	5.1E-1	------	5.1E-1	------	4.0E0	------	3.1E-1
18	1,500	8.5E-1	8.1E-1	8.6E-1	7.7E-1	------	8.1E0	------	8.0E-1

Table 5, cont.

Borehole #31, cont.

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
		Radionuclide Concentrations (pCi/g)							
20	600	------	4.9E-1	4.8E-1	5.0E-1	------	------	------	6.2E-1
22	1,300	------	7.1E-1	8.4E-1	5.9E-1	------	------	------	-------
24	1,300	------	1.1E0	1.1E-1	1.0E0	------	6.2E0	------	-------

Borehole #32

Depth	Gross NaI	U-238	Pb-214	Bi-214	Ra-226	Ra-223	K-40	Pb-211	Pb-212
		Radionuclide Concentrations (pCi/g)							
00	16,000	------	8.3E0	6.5E0	1.0E1	2.0E0	2.2E0	------	-------
01	>50,000	------	1.5E2	1.4E2	1.6E2	1.1E2	------	6.9E1	-------
02	17,000	------	4.9E1	4.1E1	5.7E1	2.0E1	3.9E0	1.9E1	-------
03	5,000	------	3.1E0	2.1E0	4.2E0	------	------	------	-------
04	1,300	------	3.1E0	2.1E0	4.2E0	------	------	------	-------
06	1,700	------	1.7E0	1.9E0	1.4E0	------	------	------	3.1E-1
08	1,700	------	1.9E0	2.2E0	1.6E0	------	8.2E0	------	3.8E-1
10	1,700	------	1.8E0	2.0E0	1.5E0	------	1.2E1	------	-------
12	1,600	------	1.6E0	1.7E0	1.5E0	------	1.2E1	------	6.0E-1
14	1,600	------	2.6E0	2.7E0	2.4E0	------	------	------	-------
16	1,800	------	1.7E0	1.5E0	1.9E0	------	------	------	7.1E-1
18	1,900	------	9.3E-1	8.7E-1	9.9E-1	------	1.4E1	------	8.5E-1

Table B - 1 : Area 1 Soil Analytical Results - Uranium-238 Decay Series

Boring	Depth (feet)	Uranium-238			Thorium-234			Uranium-234			Thorium-230			Radium-226			Lead-214			Bismuth-214			Lead-210		
		Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)		2.24			2.76			2.73			2.45			1.30			1.13			1.61			3.77		
Reference Level Concentration																									
Surface Samples		7.24			7.76			7.73			7.45			6.3			6.13			6.61			8.77		
Subsurface Samples		17.24			17.76			17.73			17.45			16.3			16.13			16.61			18.77		
AREA 1																									
WL-101	5	0.88	0.31	0.11	< MDA		1.95	1.54	0.44	0.13	2.18	0.57	0.07	1.04	0.22	0.33	1.02	0.25	0.27	1.22	0.37	0.33	< MDA		1.83
	20	1.63	0.49	0.13	1.47	0.87	1.36	1.47	0.46	0.17	1.63	0.57	0.23	0.91	0.19	0.35	0.92	0.22	0.26	0.73	0.35	0.35	1.31	1.27	1.30
WL-102	5	0.88	0.33	0.12	< MDA		1.16	1.06	0.37	0.11	4.18	1.02	0.23	1.17	0.22	0.26	1.56	0.24	0.26	< MDA		0.63	1.49	1.4	1.32
	15	1.34	0.43	0.10	< MDA		1.47	1.24	0.41	0.11	1.68	0.58	0.3	0.98	0.23	0.35	1.14	0.28	0.31	< MDA		0.64	< MDA		2.30
WL-103	5	1.60	0.48	0.16	< MDA		1.95	1.95	0.55	0.20	1.42	0.51	0.22	1.17	0.26	0.34	1.13	0.33	0.33	1.23	0.38	0.34	1.82	1.59	1.75
	10	1.12	0.34	0.14	< MDA		4.02	1.41	0.39	0.19	7.52	1.65	0.16	0.81	0.34	0.53	0.71	0.4	0.47	< MDA		0.99	< MDA		43.8
WL-104	5	0.70	0.27	0.14	< MDA		0.98	1.19	0.37	0.15	3.08	0.85	0.21	0.78	0.18	0.30	0.92	0.19	0.31	0.68	0.29	0.30	< MDA		1.17
	20	0.32	0.14	0.11	< MDA		1.16	0.52	0.19	0.10	1.26	0.47	0.21	0.39	0.19	0.34	0.36	0.22	0.26	0.59	0.33	0.34	< MDA		1.29
WL-105	10	6.94	1.28	0.14	< MDA		5.05	6.64	1.23	0.16	522	95	0.09	40.8	2.1	0.6	40	2.5	0.7	40.2	2.7	0.6	83.4	12.4	7.3
	30	1.10	0.34	0.08	1.86	1.2	1.38	1.16	0.36	0.10	1.59	0.56	0.31	0.99	0.23	0.34	0.89	0.26	0.26	< MDA		0.63	1.77	1.4	1.22
WL-106	0	105	22	2	< MDA		18.75	105	22	3	9700	1800	11.8	906	37	2	650	52	13	908	38	2	1040	135	23
	5	6.69	3.5	2.73	< MDA		2.76	11.5	4.8	4.0	731	135	0.21	18.8	1.3	0.4	19.1	1.5	2.0	18.1	1.7	0.4	47.5	6.5	3.4
	5 DUP (F)	26.4	10.1	17.2	< MDA		8.02	< MDA		35.3	766	142	0.14	128	6	1.0	110	7	6.0	128	7.00	1	212	28	10
	25	2.89	0.56	0.06	< MDA		2.02	2.7	0.53	0.06	2.38	0.55	0.14	1.26	0.25	0.4	1.62	0.29	0.29	1.06	0.41	0.40	< MDA		1.96
	25 DUP (F)	2.08	0.45	0.17	< MDA		3.82	1.9	0.42	0.18	6.49	1.37	0.12	2.92	0.35	0.31	2.94	0.44	0.33	< MDA		0.92	< MDA		26.9
WL-107	5	0.89	0.34	0.11	1.98	1.11	1.09	1.30	0.43	0.11	0.89	0.34	0.13	0.80	0.21	0.29	0.86	0.25	0.23	0.57	0.39	0.29	< MDA		1.52
	51	0.33	0.18	0.08	< MDA		1.15	0.54	0.24	0.08	0.56	0.27	0.15	0.71	0.21	0.36	0.80	0.23	0.24	< MDA		0.61	< MDA		1.98
	51 DUP (L)	0.59	0.25	0.08	< MDA		1.29	0.34	0.19	0.08	0.67	0.33	0.23	0.42	0.2	0.38	0.47	0.27	0.23	< MDA		0.51	2.06	1.54	1.65
WL-108	5	1.05	0.38	0.12	< MDA		1.22	0.74	0.31	0.10	1.21	0.42	0.16	0.95	0.25	0.37	0.96	0.27	0.29	< MDA		0.67	< MDA		2.11
WL-109	5	0.66	0.24	0.07	< MDA		1.22	0.66	0.25	0.08	0.67	0.3	0.13	0.90	0.21	0.31	0.92	0.27	0.23	< MDA		0.63	< MDA		1.35
	50	0.99	0.38	0.12	< MDA		1.81	0.57	0.27	0.11	1.1	0.36	0.2	0.95	0.21	0.30	1.01	0.25	0.29	< MDA		0.58	2.06	1.63	1.96
	50 DUP (L)	1.13	0.39	0.12	< MDA		3.94	0.83	0.32	0.11	2.43	0.71	0.26	1.36	0.37	0.56	1.47	0.48	0.47	< MDA		0.99	< MDA		46.3
WL-110	5	0.87	0.33	0.09	< MDA		1.47	1.25	0.41	0.09	0.66	0.35	0.23	0.87	0.25	0.40	1.17	0.29	0.32	< MDA		0.66	< MDA		2.42
	50	1.14	0.39	0.23	< MDA		1.25	1.17	0.4	0.20	0.87	0.29	0.12	1.01	0.21	0.31	1.2	0.24	0.28	1.04	0.34	0.30	< MDA		1.91
WL-111	0	1.04	0.46	0.18	1.72	1.3	1.27	1.70	0.63	0.25	2.12	0.72	0.29	0.91	0.22	0.33	1.05	0.27	0.32	0.96	0.32	0.33	1.82	1.52	1.79
	5	1.16	0.65	0.90	1.43	1.24	1.29	3.37	1.08	0.97	2.76	0.90	0.77	0.61	0.21	0.42	1.05	0.27	0.32	< MDA		0.54	< MDA		1.62
	5 DUP (L)	--		--	--		--	--		--	--		--	0.91	0.23	0.41	1.03	0.27	0.32	0.81	0.39	0.41	< MDA		1.96
	51	< MDA	0.32	0.48	< MDA		1.11	0.75	0.47	0.58	2.47	1.26	0.79	0.48	0.18	0.33	0.49	0.21	0.30	< MDA		0.55	< MDA		1.55
	51 DUP (L)	--		--	--		--	--		--	--		--	0.51	0.22	0.35	0.51	0.25	0.26	< MDA		0.54	< MDA		1.60
WL-112	0	1.22	0.43	0.12	< MDA		1.63	1.45	0.48	0.13	2.67	0.76	0.25	1.32	0.24	0.41	1.30	0.30	0.37	1.33	0.39	0.41	< MDA		2.31
	5	3.44	1.58	0.42	< MDA		2.55	2.92	1.46	0.89	84.4	15.8	1.9	4.66	0.46	0.42	5.14	0.56	0.34	4.35	0.68	0.42	11.2	2.80	2.90
	42	1.62	1.09	0.88	< MDA		1.74	1.74	1.15	1.06	0.92	0.44	0.42	0.76	0.20	0.34	0.90	0.25	0.26	0.61	0.31	0.34	< MDA		1.40
WL-113	5	1.25	0.54	0.26	0.58	0.58	0.46	1.40	0.59	0.32	0.33	0.15	0.11	0.97	0.08	0.06	0.88	0.11	0.06	1.06	0.11	0.06	< MDA		1.26
	5 DUP (F)	0.62	0.30	0.08	0.83	0.4	0.31	0.76	0.34	0.16	0.58	0.23	0.15	1.06	0.08	0.06	1.05	0.10	0.05	1.06	0.12	0.06	1.41	0.54	0.44
	10	1.06	0.44	0.09	< MDA		1.29	1.20	0.48	0.22	2.21	0.52	0.13	1.53	0.15	0.12	1.65	0.21	0.12	1.40	0.21	0.12	< MDA		11.40
WL-114	0	147	38	0.9	55.9	13.5	7.9	154	40	1.0	7850	1470	0.92	109	5	0.9	108	8	1	110	6	0.9	206	26	8
	5	3.54	1.38	0.51	< MDA		0.73	3.43	1.35	0.63	23.2	4.9	0.4	2.59	0.17	0.06	2.52	0.27	0.25	2.60	0.20	0.06	3.29	1.00	0.95
	5 DUP (L)	--		--	--		--	--		--	--		--	2.54	0.14	0.07	2.49	0.20	0.08	2.53	0.19	0.07	< MDA		2.34
	15	1.60	0.82	0.23	< MDA		0.72	1.29	0.74	0.56	1.08	0.46	0.28	0.98	0.08	0.07	0.99	0.12	0.07	0.97	0.12	0.07	< MDA		1.41
	15 DUP (L)	--		--	--		--	--		--	--		--	0.97	0.08	0.07	0.97	0.11	0.09	0.97	0.13	0.07	< MDA		2.74
WL-115	5	1.22	0.49	0.21	< MDA		0.31	1.30	0.52	0.29	0.84	0.29	0.18	1.00	0.08	0.06	0.99	0.10	0.06	0.99	0.12	0.06	0.98	0.45	0.49
	40	0.33	0.20	0.11	0.52	0.36	0.25	0.35	0.21	0.16	0.29	0.16	0.12	0.58	0.05	0.05	0.59	0.07	0.05	0.58	0.08	0.05	0.72	0.45	0.40
WL-116	0	0.88	0.34	0.15	< MDA		3.84	1.04	0.38	0.20	1.94	0.69	0.52	0.94	0.21	0.33	0.94	0.27	0.29	< MDA		0.61	< MDA		29.9
	5	1.18	0.50	0.41	1.07	0.48	0.31	1.15	0.49	0.36	0.51	0.21	0.13	1.11	0.08	0.06	1.13	0.11	0.06	1.07	0.12	0.06	1.44	0.59	0.48
	5 DUP (F)	1.03	0.51	0.20	< MDA		1.32	0.64	0.39	0.28	0.35	0.17	0.11	1.18	0.13	0.13	1.11	0.17	0.13	1.24	0.18	0.13	< MDA		11.30
	10	1.32	0.41	0.05	0.73	0.37	0.31	1.14	0.37	0.17	0.36	0.2	0.21	1.00	0.07	0.05	1.02	0.09	0.04	0.98	0.1	0.05	1.15	0.42	0.39
WL-117	10	2.90	0.86	0.16	1.44	0.59	0.59	1.72	0.61	0.25	36.58	7.4	0.13	3.15	0.19	0.07	2.92	0.23	0.08	3.22	0.23	0.07	5.82	1.11	0.87
	25	0.56	0.31	0.10	< MDA		0.58	0.56	0.31	0.17	0.7	0.28	0.15	0.62	0.06	0.05	0.58	0.08	0.06	0.68	0.09	0.05	< MDA		1.14
WL-118	5	17.8	4.1	0.2	< MDA		3.05	15.6	3.6	0.2	425	87	2.5	18.4	1	0.3	19.9	1.6	0.3	18.4	1.2	0.3	< MDA		40.3
	10	1.14	0.47	0.17	0.82	0.35	0.31	1.18	0.48	0.18	7.19	1.88	0.2	1.31	0.1	0.05	1.24	0.11	0.05	1.17	0.11	0.05	0.97	0.62	0.54
WL-119	5	0.72	0.35	0.17	0.85	0.42	0.33	0.51	0.29	0.21	0.6	0.28	0.22	0.89	0.07	0.06	0.89	0.09	0.05	0.91	0.11	0.06	1.06	0.47	0.45
	50	< MDA	0.36	0.58	< MDA		0.23	0.85	0.53	0.50	0.67	0.35	0.41	0.46	0.05	0.04	0.44	0.06	0.04	0.48	0.07	0.04	< MDA		0.35
	50 DUP (L)	--		--	--		--	--		--	--		--	0.48	0.05	0.06	0.49	0.07	0.06	0.46	0.07	0.06	< MDA		2.39
	50 DUP (F)	0.36	0.23	0.25	0.5	0.3	0.24	0.57	0.29	0.19	0.22	0.13	0.11	0.45	0.05	0.06	0.43	0.06	0.04	0.46	0.07	0.06	0.62	0.38	0.37

Table B - 1 : Area 1 Soil Analytical Results - Uranium-238 Decay Series

Boring	Depth (feet)	Uranium-238			Thorium-234			Uranium-234			Thorium-230			Radium-226			Lead-214			Bismuth-214			Lead-210		
		Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)		**2.24**			**2.76**			**2.73**			**2.45**			**1.30**			**1.13**			**1.61**			**3.77**		
Reference Level Concentration																									
Surface Samples		**7.24**			**7.76**			**7.73**			**7.45**			**6.3**			**6.13**			**6.61**			**8.77**		
Subsurface Samples		**17.24**			**17.76**			**17.73**			**17.45**			**16.3**			**16.13**			**16.61**			**18.77**		
WL-120	5	**0.95**	0.38	*0.18*	**0.85**	0.54	*0.45*	**1.15**	0.43	*0.26*	**0.48**	0.18	*0.12*	**1.00**	0.09	*0.07*	**0.96**	0.11	*0.07*	**1.04**	0.13	*0.07*	*MDA*		*0.78*
	50	**0.52**	0.25	*0.12*	*MDA*		*1.17*	**0.46**	0.23	*0.14*	**0.32**	0.19	*0.15*	**0.92**	0.1	*0.11*	**0.85**	0.13	*0.11*	**1.04**	0.16	*0.11*	*MDA*		*9.35*
	50 DUP (F)	**0.92**	0.46	*0.38*	**0.76**	0.54	*0.64*	**0.98**	0.47	*0.35*	**0.38**	0.19	*0.21*	**1.07**	0.09	*0.09*	**1.05**	0.12	*0.08*	**1.11**	0.13	*0.09*	**1.03**	0.63	*0.81*
WL-121	0	**0.94**	0.27	*0.17*				**0.78**	0.24	*0.13*	**1.57**	0.36	*0.1*	*7.28*		*7.28*	**1.62**	0.56	*0.59*	*1.28*		*1.28*	*< 1910*		*1910*
WL-122	0	**0.87**	0.25	*0.09*				**0.94**	0.26	*0.1*	**1.93**	0.43	*0.12*	*< 5.44*		*5.44*	**1.08**	0.5	*0.44*	*< 1*		*1*	*3.66*		*3.66*
WL-123	0	**2.33**	0.54	*0.12*				**2.94**	0.65	*0.07*	**1.45**	0.34	*0.07*	*< 5.98*		*5.98*	**1.16**	0.44	*0.38*	*< 0.97*		*0.97*	*< 3.45*		*3.45*
WL-124	0	**1.02**	0.26	*0.06*				**1.5**	0.34	*0.06*	**2.16**	0.49	*0.07*	*< 5.22*		*5.22*	*< 1.02*		*1.02*	*1.05*		*1.05*	**950**	1650	*771*
BACKGROUND SURFACE SOIL																									
Borrow Pit - loess	0	**1.30**	0.50	*0.19*	**1.15**	0.89	*1.04*	**1.06**	0.44	*0.20*	**0.92**	0.44	*0.37*	**1.19**	0.22	*0.29*	**1.07**	0.24	*0.23*	*MDA*		*0.75*	**2.40**	1.30	*1.31*
Borrow Pit - shale	0	**1.85**	0.79	*0.25*	**1.99**	1.11	*1.08*	**2.40**	0.93	*0.36*	**1.41**	0.42	*0.18*	**0.97**	0.2	*0.34*	**1.01**	0.26	*0.26*	**0.90**	0.31	*0.34*	**1.88**	1.56	*1.23*
Farmer's Field	0	**1.41**	0.5	*0.15*	*MDA*		*1.80*	**1.11**	0.43	*0.20*	**2.03**	0.6	*0.17*	**1.13**	0.25	*0.35*	**1.02**	0.33	*0.35*	**1.27**	0.4	*0.35*	**3.16**	2.18	*2.04*
McLaren/Hart Shop	0	**0.74**	0.35	*0.14*	*MDA*		*1.35*	**1.32**	0.5	*0.23*	**1.68**	0.59	*0.32*	**0.95**	0.22	*0.31*	**0.92**	0.26	*0.31*	*< MDA*		*0.70*	*< MDA*		*1.79*

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.

* = Nuclear Regulatory Commission's Branch Technical Position (BTP) criteria for thorium-230 and radium-226, which are established at levels of background plus 5 pCi/g for surface samples and background plus 15 pCi/g for subsurface samples (15 cm depth), have been selected as reference values for comparison of all soil ananlytical data. Although this criteria is appropriate specifically for these two radionuclides, they are conservative values for comparison of all data. If no background concentration is established for a specific radionuclide, then a reference value of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples have been conservatively selected for comparison of the data.

-- = Not reported

DUP (F) = Field duplicate

DUP (L) = Laboratory duplicate

MDA = Minimum Detectable Activity

NE = Not Established

NA = Not available.

Bolded numbers indicate result reported above the minimum detectable activity (MDA).

Table B - 2 : Area 2 Soil Analytical Results - Uranium-238 Decay Series

Boring	Depth	Uranium-238			Thorium-234			Uranium-234			Thorium-230			Radium-226			Lead-214			Bismuth-214			Lead-210		
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)		2.24			2.76			2.73			2.45			1.30			1.13			1.61			3.77		
Reference Level Concentration																									
Surface Samples		7.24			7.76			7.73			7.45			6.3			6.13			6.61			8.77		
Subsurface Samples		17.24			17.76			17.73			17.45			16.3			16.13			16.61			18.77		
AREA 2																									
WL-207	5	0.66	0.33	0.20	NE	NE	NE	0.8	0.37	0.22	1.21	0.70	0.54	< MDA		0.93	0.68	0.53	0.48	< MDA		0.93	< MDA		50.2
	5 DUP (L)	0.89	0.39	0.21	1.60	0.71	1.07	0.85	0.38	0.23	1.12	0.88	0.88	0.68	0.18	0.24	0.75	0.23	0.24	0.49	0.26	0.24	< MDA		1.28
	10	0.81	0.36	0.21	< MDA		1.12	0.71	0.34	0.21	1.78	1.43	1.43	0.76	0.22	0.33	0.95	0.26	0.23	0.57	0.38	0.33	< MDA		1.31
WL-208	5	1.60	0.50	0.10	< MDA		3.92	2.05	0.59	0.12	123	23	0.10	3.26	0.32	0.37	3.39	0.45	0.33	3.05	0.47	0.37	< MDA		26.9
	5 DUP (L)	2.82	0.76	0.13	2.64	1.82	1.66	2.27	0.65	0.19	94.9	17	0.23	3.40	0.34	0.38	3.29	0.39	0.34	3.36	0.53	0.38	7.37	2.49	2.50
	9	1.75	0.48	0.15	2.07	0.86	1.59	1.65	0.47	0.19	10.07	2	0.07	1.35	0.23	0.25	1.55	0.25	0.22	< MDA		0.61	2.08	1.45	1.75
WL-209	0	294	92	0.7	< MDA		93.30	575	180	0.7	29240	5290	0.10	3720	142	10	3190	277	38	3690	136	10	< MDA		1170
	5	249	43	0.14	< MDA		66.82	335	57	0.19	38280	7750	40.2	2970	123	7	685	124	34	3000	122	7	< MDA		810
	5 DUP (F)	287	47	0.15	49.4	16.2	21.8	527	87	0.20	32680	6420	29.0	3140	116	5	1080	139	26	3150	111	5	1170	145	28
	25	0.58	0.23	0.12	< MDA		3.07	0.46	0.22	0.23	26.9	5.4	0.12	0.85	0.18	0.29	0.91	0.26	0.29	0.78	0.26	0.29	< MDA		26.9
	25 DUP (F)	0.61	0.24	0.08	< MDA		1.28	0.59	0.24	0.09	12.85	3.7	0.72	0.62	0.2	0.27	0.61	0.25	0.26	< MDA		0.50	2.94	1.5	1.59
WL-210	0	134	42	0.6	< MDA		29.51	216	67	0.7	18190	3510	15.1	2280	89	4	1450	179	22	2300	84	4	1370	162	28
	5	65.5	11.2	0.12	< MDA		32.11	145	25	0.18	12400	2140	0.14	520	26	3	546	38	3	512	28	3	< MDA		372
	5 DUP (F)	128	22	0.14	13.2	15.7	8.9	267	46	0.17	15610	2700	0.11	458	20	2	368	25	2	468	20	2	583	72	12
	40	0.91	0.31	0.11	< MDA		1.25	0.69	0.26	0.12	18.2	3.3	0.12	0.68	0.18	0.31	0.80	0.21	0.28	0.62	0.28	0.31	< MDA		1.90
	40 DUP (F)	0.54	0.23	0.09	< MDA		3.94	0.93	0.32	0.11	10.8	2.2	0.1	1.66	0.4	0.59	1.82	0.53	0.45	1.40	0.64	0.59	< MDA		57.9
WL-211	5	2.61	0.64	0.11	< MDA		1.98	2.30	0.58	0.10	66.11	11.8	0.15	8.52	0.58	0.33	8.47	0.63	0.32	8.01	0.87	0.33	22.4	3.5	2.1
	25	0.66	0.27	0.26	< MDA		2.85	0.68	0.28	0.26	4.97	1.04	0.16	0.42	0.19	0.31	< MDA		0.40	< MDA		0.46	< MDA		26.9
WL-212	5	1.66	0.47	0.12	< MDA		3.74	1.57	0.46	0.17	5.73	1.2	0.10	1.26	0.4	0.46	< MDA		0.83	1.20	0.56	0.46	< MDA		46.9
	10	1.77	0.51	0.12	< MDA		1.19	1.86	0.53	0.14	116	20	0.23	1.77	0.24	0.28	1.95	0.24	0.26	1.63	0.42	0.28	4.02	1.6	1.34
WL-213	0	1.53	0.55	0.42	2.05	1.31	1.51	1.64	0.58	0.45	24.2	4.7	0.2	1.00	0.26	0.37	1.28	0.28	0.28	< MDA		0.70	2.36	1.4	2.13
	5	1.53	0.49	0.13	< MDA		3.50	1.00	0.38	0.19	17.29	3.4	0.16	1.26	0.23	0.27	1.32	0.32	0.30	< MDA		0.63	< MDA		26.9
	25	0.45	0.22	0.13	< MDA		3.63	1.06	0.36	0.14	3.13	0.75	0.05	0.93	0.33	0.52	1.06	0.38	0.44	< MDA		0.85	< MDA		50.3
WL-214	5	0.81	0.3	0.09	1.14	0.74	1.08	1.09	0.36	0.12	44.4	7.8	0.21	0.95	0.18	0.22	1.01	0.19	0.23	< MDA		0.62	< MDA		1.23
	25	0.67	0.28	0.12	< MDA		3.23	0.97	0.35	0.11	12.8	2.5	0.18	< MDA		0.52	0.74	0.25	0.32	< MDA		0.52	< MDA		26.9
WL-215	0	1.53	0.68	0.45	< MDA		1.39	1.86	0.76	0.48	5.35	1.14	0.07	0.70	0.20	0.29	0.75	0.23	0.28	0.58	0.37	0.29	< MDA		1.75
WL-216	5	11.4	3.8	2.20	< MDA		7.06	12.5	4.0	1.90	1131		0.93	88.4	5.2	0.9	85.9	6.4	4.6	93.2	5.1	0.9	176	22	9
	25	0.97	0.32	0.09	< MDA		1.04	0.81	0.29	0.09	1.46	0.46	0.17	1.03	0.21	0.39	0.93	0.25	0.29	1.17	0.34	0.39	< MDA		1.43
WL-217	5	0.51	0.21	0.08	< MDA		1.80	0.45	0.2	0.08	0.96	0.3	0.13	0.60	0.21	0.31	0.53	0.23	0.23	< MDA		0.52	1.71	1.54	1.36
	10	0.96	0.31	0.12	< MDA		1.10	1.03	0.33	0.17	8.95	1.90	0.12	1.27	0.24	0.29	1.30	0.29	0.28	1.24	0.37	0.29	2.11		1.38
WL-218	0	1.12	0.48	0.16	0.98	0.81	0.82	1.53	0.59	0.24	1.77	0.57	0.14	1.06	0.19	0.24	1.07	0.22	0.21	1.02	0.33	0.24	1.90	1.51	1.28
	5	0.81	0.3	0.12	< MDA		1.67	0.73	0.28	0.12	1.19	0.43	0.14	0.85	0.20	0.41	0.94	0.22	0.34	1.00	0.37	0.41	< MDA		2.36
	40	0.53	0.24	0.11	< MDA		1.56	0.84	0.32	0.12	7.27	1.51	0.1	0.68	0.23	0.43	0.62	0.31	0.28	< MDA		0.60	1.76	1.61	0.16
WL-219	5	1.09	0.35	0.09	< MDA		1.82	0.91	0.31	0.09	1.07	0.4	0.15	1.12	0.26	0.33	1.32	0.33	0.36	1.06	0.36	0.33	< MDA		2.41
	10	0.60	0.38	0.33	1.93	1.04	1.06	1.16	0.56	0.39	0.64	0.25	0.08	0.62	0.22	0.41	0.86	0.26	0.31	< MDA		0.55	< MDA		1.46
WL-220	5	1.00	0.33	0.09	< MDA		1.60	1.16	0.36	0.09	1.53	0.46	0.11	0.81	0.23	0.36	0.90	0.27	0.31	< MDA		0.61	< MDA		2.04
	25	0.95	0.34	0.13	< MDA		1.22	0.89	0.33	0.12	0.56	0.27	0.11	0.78	0.24	0.38	0.82	0.29	0.36	< MDA		0.66	< MDA		1.55
WL-221	5	0.82	0.31	0.13	< MDA		1.39	1.12	0.38	0.13	4.28	0.94	0.24	0.75	0.2	0.34	0.92	0.25	0.30	0.81	0.29	0.34	< MDA		2.08
	35	0.50	0.21	0.11	< MDA		1.62	0.52	0.21	0.1	1.24	0.41	0.16	< MDA		0.33	< MDA		0.35	< MDA		0.51	< MDA		2.21
WL-222	0	3.36	1.04	0.42	< MDA		5.69	2.26	0.79	0.25	131	25	0.19	2.94	0.59	0.53	2.41	0.8	0.63	3.56	0.87	0.51	< MDA		69.0
	5	1.21	0.38	0.09	1.41	1.04	1.20	1.46	0.43	0.13	81.4	15.4	0.76	1.80	0.26	0.29	1.85	0.27	0.27	1.81	0.43	0.29	4.45	1.86	1.42
	30	0.40	0.23	0.12	< MDA		3.57	0.51	0.26	0.12	0.88	0.32	0.21	0.82	0.39	0.60	< MDA		0.74	< MDA		0.60	< MDA		51.2
WL-223	5	1.22	0.36	0.10	< MDA		1.82	1.44	0.41	0.11	9.16	1.97	0.12	1.73	0.27	0.30	1.77	0.33	0.31	1.82	0.38	0.30	< MDA		2.15
	22	1.93	0.54	0.15	< MDA		1.62	2.37	0.62	0.14	0.68	0.28	0.12	0.52	0.19	0.33	0.61	0.27	0.29	< MDA		0.50	< MDA		1.65
WL-224	5	0.63	0.41	0.40	< MDA		1.45	0.75	0.5	0.68	2.85	1.31	1.15	0.84	0.21	0.28	0.73	0.27	0.30	0.93	0.31	0.28	< MDA		1.71
	35	0.77	0.78	0.52	< MDA		1.92	1.13	0.96	0.80	4.08	1.71	0.84	1.00	0.22	0.37	1.18	0.25	0.32	0.84	0.34	0.37	1.94	1.64	1.70
WL-225	5	1.29	1.04	1.01	< MDA		1.40	3.17	1.69	1.22	2.84	1.44	1.32	1.07	0.27	0.40	1.11	0.35	0.30	0.93	0.41	0.40	2.73	2.15	1.82
	35	< MDA		0.77	< MDA		1.66	0.72	0.42	0.40	0.91	0.91	0.23	< MDA		0.51	0.54	0.31	0.41	< MDA		0.72	< MDA		2.17
WL-226	10	1.63	0.65	0.29	< MDA		2.17	1.38	0.62	0.52	14.1	4	1.1	1.4	0.27	0.34	1.40	0.35	0.36	1.25	0.41	0.34	4.35	1.78	2.10
	20	6.32	2.24	0.91	2.55	1.82	2.31	6.02	2.2	1.31	173	31	1.0	3.26	0.44	0.40	3.26	0.47	0.42	< MDA		1.21	5.93	2.32	2.62
WL-227	5	2.01	0.71	0.32	< MDA		1.53	1.68	0.67	0.57	20.4	4.7	0.9	1.32	0.22	0.29	1.38	0.26	0.26	0.92	0.38	0.29	2.35	1.44	1.45
	40	< MDA	0.30	0.53	< MDA		0.98	0.66	0.43	0.55	2.78	1.32	0.94	0.43	0.18	0.24	0.51	0.19	0.25	< MDA		0.54	1.81	1.43	1.14
WL-228	5	1.84	1.19	1.3	< MDA		1.18	1.50	1.09	1.37	2.72	1.45	1.05	0.79	0.20	0.30	0.75	0.24	0.29	0.79	0.35	0.30	< MDA	NA	1.35
	15	< MDA	0.39	0.78	< MDA		2.01	< MDA	0.46	0.74	2.13	0.76	0.46	0.64	0.25	0.37	0.60	0.31	0.33	< MDA		0.63	< MDA		2.17
WL-229	5	1.45	0.6	0.39	1.81	0.97	1.29	0.82	0.47	0.52	4.97	1.89	0.97	1.15	0.28	0.70	0.98	0.28	0.26	< MDA		0.70	1.82	1.57	1.78
	20	0.54	0.36	0.39	< MDA		1.19	0.79	0.46	0.56	1.17	0.89	1.02	0.38	0.19	0.34	0.45	0.25	0.21	< MDA		0.50	< MDA	NA	2.07

Table B - 2 : Area 2 Soil Analytical Results - Uranium-238 Decay Series

Boring	Depth	Uranium-238			Thorium-234			Uranium-234			Thorium-230			Radium-226			Lead-214			Bismuth-214			Lead-210		
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)		**2.24**			**2.76**			**2.73**			**2.45**			**1.30**			**1.13**			**1.61**			**3.77**		
Reference Level Concentration																									
Surface Samples		**7.24**			7.76			7.73			7.45			**6.3**			**6.13**			**6.61**			**8.77**		
Subsurface Samples		**17.24**			**17.76**			**17.73**			17.45			**16.3**			**16.13**			**16.61**			**18.77**		
WL-230	5	**0.92**	0.48	0.16	MDA		2.05	**2.23**	0.81	0.49	**26.8**	6.4	1.3	**1.67**	0.26	0.34	**1.56**	0.27	0.28	**1.93**	0.46	0.34	**2.26**	1.73	1.97
	35	**2.05**	1.23	0.46	< MDA		1.86	**1.75**	1.18	1.18	**1.33**	0.98	1.25	**0.53**	0.22	0.36	**0.33**	0.33	0.29	< MDA		0.52	< MDA	NA	1.60
WL-231	0	**2.04**	0.79	0.26	< MDA		3.26	**3.18**	1.06	0.32	**1.21**	0.39	0.20	**0.91**	0.22	0.29	**1.01**	0.29	0.30	< MDA		0.57	< MDA		29.9
	5	**3.86**	2.03	2.18	**2.48**	1.21	1.41	**6.97**	2.76	2.14	**94.5**	17.4	1.0	**4.06**	0.37	0.28	**3.96**	0.40	0.34	**4.18**	0.57	0.28	**5.59**	2.15	1.70
	10	**2.01**	0.74	0.15	MDA		1.39	**2.29**	0.82	0.53	**10.2**	3.0	1.4	**1.37**	0.24	0.40	**1.42**	0.27	0.27	< MDA		0.71	**2.73**	1.92	1.80
WL-233	27	**4.48**	2.17	1.80	**2.03**	1.50	1.97	**4.58**	2.18	1.64	**427**	80	0.70	**4.44**	0.46	0.38	**4.26**	0.51	0.36	**4.43**	0.70	0.38	**9.83**	2.56	2.87
	30	**1.99**	1.49	1.93	< MDA		1.74	**2.60**	1.76	2.34	**9.93**	2.72	0.9	**0.79**	0.20	0.41	**0.87**	0.24	0.34	**0.76**	0.30	0.41	**1.89**	1.52	1.69
WL-234	10	**138**	42	5.0	**24.5**	15.8	19.9	**128**	39	5	**57300**	19300	238	**3060**	116	4	**1100**	95	25	**3060**	108	4	**1300**	157	24
	10 DUP (F)	**60.7**	12.4	11	MDA		14.65	**45.4**	9.7	0.5	**12000**	3670	116	**1260**	49	3	**592**	51	16	**1260**	48	3	**839**	103	18
	20	**0.98**	0.44	0.28	< MDA		1.70	**0.94**	0.45	0.37	**16.2**	3.2	0.04	< MDA		0.66	**1.18**	0.32	0.31	< MDA		0.66	< MDA		2.20
	20 DUP (F)	**2.11**	1.47	0.99	**2.08**	1.29	1.7	**1.64**	1.29	0.99	**11.3**	2.2	0.5	**1.18**	0.26	0.39	**0.99**	0.35	0.32	**1.34**	0.39	0.39	< MDA		2.15
WL-235	0	**0.77**	0.4	0.37	MDA		1.82	**0.97**	0.45	0.31	**12.4**	2.48	0.13	**0.90**	0.21	0.32	**0.94**	0.26	0.29	< MDA		0.61	**1.56**	1.66	1.47
	5	**0.91**	0.5	0.50	< MDA		4.87	**1.47**	0.66	0.61	**3.21**	1.45	1.16	**0.74**	0.46	0.56	< MDA		0.86	< MDA		0.92	< MDA		59.3
	30	**1.31**	0.53	0.24	MDA		2.09	**1.25**	0.53	0.41	**3.15**	1.43	1.0	**1.09**	0.25	0.43	**1.18**	0.27	0.29	**1.00**	0.45	0.43	< MDA	NA	2.06
WL-236	5	**1.56**	1.21	0.60	< MDA		2.02	**1.43**	1.22	1.41	**5.92**	1.49	0.97	**1.03**	0.23	0.34	**1.14**	0.24	0.33	< MDA		0.68	< MDA		1.75
	35	**1.95**	1.29	0.82	**2.45**	1.15	1.26	**2.37**	1.43	0.54	**4.9**	1.33	1.01	**1.01**	0.24	0.35	**1.02**	0.28	0.31	< MDA		0.67	**1.79**	1.36	1.77
WL-239	5	**1.22**	0.45	0.14	MDA		1.13	**1.24**	0.46	0.19	**0.5**	0.2	0.12	**0.96**	0.11	0.10	**0.89**	0.14	0.1	**1.01**	0.16	0.10	< MDA		8.86
	25	**0.48**	0.36	0.47	**1.24**	0.88	0.89	**0.83**	0.46	0.46	**0.58**	0.26	0.25	**0.90**	0.08	0.06	**0.83**	0.09	0.06	**0.87**	0.11	0.06	< MDA		2.65
WL-241	5	**3.90**	1.07	0.18	MDA		0.94	**4.51**	1.20	0.15	**343**	66	0.11	**12.9**	0.54	0.1	**12.5**	0.9	0.1	**12.6**	0.6	0.1	**26.7**	3.6	1.1
	15	**0.64**	0.30	0.13	**0.75**	0.51	0.46	**0.59**	0.29	0.20	**0.57**	0.21	0.13	**1.04**	0.09	0.07	**0.98**	0.12	0.07	**1.12**	0.13	0.07	**1.63**	0.64	0.78
WL-242	0	**1.63**	0.46	0.13	< MDA		3.85	**1.83**	0.5	0.17	**8.63**	2.62	0.76	**1.57**	0.26	0.51	**1.59**	0.34	0.28	**1.48**	0.4	0.51	< MDA		29.8
	2	**0.75**	0.3	0.1	MDA		4.91	**1.35**	0.43	0.1	**21.3**	5.3	1.11	**2.42**	0.45	0.59	**2.45**	0.59	0.55	< MDA		1.24	< MDA		66.3
WL-243	0	**3.63**	0.91	0.18	MDA		1.94	**3.99**	0.98	0.24	**265**	50	0.22	**4.78**	0.44	0.33	**5.26**	0.49	0.28	**4.2**	0.67	0.33	**9.58**	2.32	2.07
WL-244	0	**1.35**	0.4	0.09	MDA		1.24	**0.88**	0.3	0.12	**20.8**	4.1	0.71	**1.54**	0.22	0.33	**1.58**	0.26	0.21	**1.31**	0.35	0.33	**2.02**	1.29	1.48
WL-245	0	**0.71**	0.27	0.18	MDA		1.70	**0.93**	0.32	0.23	**3.92**	0.93	0.16	**0.95**	0.26	0.34	**1**	0.4	0.29	< MDA		0.65	< MDA		2.02
WL-246	0	**0.73**	0.28	0.18	< MDA		1.93	**0.94**	0.32	0.14	**2.91**	0.82	0.3	**1.04**	0.26	0.37	**0.91**	0.34	0.3	**1.09**	0.36	0.37	< MDA		1.63
BACKGROUND SURFACE SOIL																									
Barrow Pit - loess	0	**1.30**	0.50	0.19	**1.15**	0.89	1.04	**1.06**	0.44	0.20	**0.92**	0.44	0.37	**1.19**	0.22	0.29	**1.07**	0.24	0.23	< MDA		0.75	**2.40**	1.30	1.31
Barrow Pit - shale	0	**1.85**	0.79	0.25	**1.99**	1.11	1.08	**2.40**	0.93	0.36	**1.41**	0.42	0.18	**0.97**	0.2	0.34	**1.01**	0.26	0.26	**0.90**	0.31	0.34	**1.88**	1.56	1.23
Farmer's Field	0	**1.41**	0.5	0.15	MDA		1.80	**1.11**	0.43	0.20	**2.03**	0.6	0.17	**1.13**	0.25	0.35	**1.02**	0.33	0.35	**1.27**	0.4	0.35	**3.16**	2.18	2.04
McLaren Hart Shop	0	**0.74**	0.35	0.14	< MDA		1.35	**1.32**	0.5	0.23	**1.68**	0.59	0.32	**0.95**	0.22	0.31	**0.92**	0.26	0.31	< MDA		0.70	< MDA		1.79

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.
* = Nuclear Regulatory Commission's Branch Technical Position (BTP) criteria for thorium-230 and radium-226, which are established at levels of background plus 5 pCi/g for surface samples and background plus 15 pCi/g for subsurface samples (15 cm depth), have been selected as reference values for comparison of all soil ananlytical data. Although this criteria is appropriate specifically for these two radionuclides, they are conservative values for comparison of all data. If no background concentration is established for a specific radionuclide, then a reference value of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples have been conservatively selected for comparison of the data.
-- = Not reported
DUP (F) = Field duplicate
DUP (L) = Laboratory duplicate
MDA = Minimum Detectable Activity
NE = Not Established
NA = Not available.
Bolded numbers indicate result reported above the minimum detectable activity (MDA).

Table B - 3 : Area 1 Soil Analytical Results - Uranium-235 Decay Series

Boring	Depth (feet)	Uranium-235/236 Result	+/- Sigma	MDA	Uranium-235 Result	+/- Sigma	MDA	Protactinium-231 Result	+/- Sigma	MDA	Actinium-227 Result	+/- Sigma	MDA	Radium-223 Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)			**1.15**			**NE**			**NE**			**NE**			**NE**	
Reference Level Concentration *																
Surface Samples			**6.15**			**5**			**5**			**5**			**5**	
Subsurface Samples			**16.15**			**15**			**15**			**15**			**15**	
AREA 1																
WL-101	5	**0.13**	0.12	0.11	< MDA		0.72	< MDA		4.25	< MDA		0.77	< MDA		11.45
	20	< MDA	0.14	0.16	< MDA		0.54	< MDA		3.15	< MDA		0.69	< MDA		8.49
WL-102	5	< MDA	0.09	0.16	< MDA		0.49	< MDA		3.79	< MDA		0.74	< MDA		8.77
	15	< MDA		0.09	< MDA		0.83	< MDA		4.62	< MDA		1.04	< MDA		13.54
WL-103	5	**0.21**	0.17	0.16	< MDA		0.73	< MDA		4.52	< MDA		0.89	< MDA		9.63
	10	**0.23**	0.16	0.16	< MDA		1.41	< MDA		8.51	< MDA		1.40	< MDA		15.56
WL-104	5	< MDA	0.14	0.18	< MDA		0.55	< MDA		2.80	< MDA		0.60	< MDA		7.84
	20	**0.25**	0.14	0.12	< MDA		0.56	< MDA		3.60	< MDA		0.59	< MDA		6.49
WL-105	10	**0.55**	0.24	0.14	**3.95**	0.73	1.97	**26.9**	7.9	10.0	**15.0**	2.6	1.9	**16.8**		6.3
	30	< MDA	0.004	0.11	< MDA		0.73	< MDA		4.99	< MDA		0.88	< MDA		9.36
WL106	0	**6.86**	3.99	3.10	**75.5**	8.5	8.7	**544**	61	41	**305**	33	8	**293**		25
	5	< MDA	1.95	3.87	**2.10**	0.43	1.12	**11.1**	3.9	5.9	**6.3**	1.29	1.73	**6.67**		3.90
	5 DUP (L)	--	--	--	--	--	--	--	--	--	--	--	--	< MDA	--	5.80
	5 DUP (F)	< MDA	11.2	25.5	**12.1**	1.7	3.4	**73.2**	14.6	16.9	**43.8**	5.8	3.20	**44.3**		10.0
	25	**0.24**	0.12	0.07	< MDA		0.78	< MDA		4.41	< MDA		0.81	< MDA		9.87
	25 DUP (F)	< MDA	0.09	0.14	< MDA		1.14	< MDA		5.51	< MDA		1.34	< MDA		11.06
WL-107	5	< MDA	0.09	0.11	< MDA		0.58	< MDA		3.81	< MDA		0.71	< MDA		13.99
	51	< MDA	0.0014	0.095	< MDA		0.63	< MDA		4.11	< MDA		0.65	< MDA		15.08
	51 DUP (L)	< MDA	0.002	0.11	< MDA		0.63	< MDA		4.42	< MDA		1.08	< MDA		13.37
WL-108	5	< MDA	0.07	0.13	< MDA		0.67	< MDA		4.43	< MDA		0.96	< MDA		13.65
WL-109	5	< MDA	0.08	0.09	< MDA		0.61	< MDA		3.91	< MDA		0.70	< MDA		14.48
	50	< MDA	0.1	0.14	< MDA		0.77	< MDA		4.35	< MDA		1.22	< MDA		9.22
	50 DUP (L)	**0.09**	0.11	0.12	< MDA		1.28	< MDA		6.61	< MDA		1.68	< MDA		15.02
WL-110	5	< MDA	0.09	0.08	< MDA		0.84	< MDA		5.20	< MDA		1.26	< MDA		14.87
	50	< MDA	0.16	0.25	< MDA		0.74	< MDA		4.39	< MDA		1.23	< MDA		10.36
WL-111	0	**0.72**	0.41	0.23	< MDA		0.70	< MDA		4.20	< MDA		1.05	< MDA		14.77
	5	< MDA	0.66	1.49	< MDA		0.70	< MDA		4.22	< MDA		1.11	< MDA		21.48
	5 DUP (L)	--		--	--		--	< MDA		4.92	< MDA		1.19	< MDA		27.47
	51	< MDA	0.3	0.35	< MDA		0.64	< MDA		3.64	< MDA		0.64	< MDA		20.60
	51 DUP (L)	--		--	--		--	< MDA		4.74	< MDA		0.89	< MDA		23.32
WL-112	0	**0.24**	0.19	0.17	< MDA		0.85	< MDA		5.45	< MDA		1.32	< MDA		16.78
	5	< MDA	0.4	1.1	< MDA		0.99	< MDA		6.84	< MDA		1.59	< MDA		36.70
	42	**0.83**	0.84	0.56	< MDA		0.56	< MDA		3.52	< MDA		0.66	< MDA		21.75
WL-113	5	**0.60**	0.38	0.24	< MDA		0.23	< MDA		1.01	< MDA		0.32	< MDA		3.26
	5 DUP (F)	< MDA	0.07	0.19	< MDA		0.17	< MDA		0.72	< MDA		0.17	< MDA		2.88
	10	**0.27**	0.22	0.23	< MDA		0.42	< MDA		2.09	< MDA		0.62	< MDA		7.47
WL-114	0	**19.5**	5.9	1.1	**17.6**	2.1	3.0	**156**	27	14	**118**	14	3	**113**		8
	5	**0.82**	0.63	0.51	**0.32**	0.06	0.27	**1.93**	0.72	1.09	**1.2**	0.23	0.22	< MDA		4.77
	5 DUP (L)	--		--	--		--	**2.42**	1.05	1.35	**1.07**	0.25	0.28	< MDA		4.68
	15	< MDA	0.43	0.44	< MDA		0.24	< MDA		1.08	< MDA		0.35	< MDA		3.71
	15 DUP (L)	--		--	--		--	< MDA		1.34	< MDA		1.48	< MDA		4.41

Table B - 3 : Area 1 Soil Analytical Results - Uranium-235 Decay Series

Boring	Depth (feet)	Uranium-235/236 Result	Uranium-235/236 +/- Sigma	Uranium-235/236 MDA	Uranium-235 Result	Uranium-235 +/- Sigma	Uranium-235 MDA	Protactinium-231 Result	Protactinium-231 +/- Sigma	Protactinium-231 MDA	Actinium-227 Result	Actinium-227 +/- Sigma	Actinium-227 MDA	Radium-223 Result	Radium-223 +/- Sigma	Radium-223 MDA
Site Specific Background(Mean+2 Std Dev)		**1.15**			**NE**			**NE**			**NE**			**NE**		
Reference Level Concentration *																
Surface Samples		**6.15**			**5**			**5**			**5**			**5**		
Subsurface Samples		**16.15**			**15**			**15**			**15**			**15**		
WL-115	5	**0.47**	0.31	0.31	< MDA		0.15	< MDA		0.85	< MDA		0.18	< MDA		2.77
	40	< MDA	0.06	0.13	< MDA		0.13	< MDA		0.67	< MDA		0.14	< MDA		2.21
WL-116	0	< MDA	0.12	0.20	< MDA		1.02	< MDA		5.37	< MDA		1.38	< MDA		21.59
	5	< MDA	0.22	0.52	< MDA		0.17	< MDA		0.89	< MDA		0.19	< MDA		2.89
	5 DUP (F)	< MDA	0.24	0.24	< MDA		0.44	< MDA		2.26	< MDA		0.68	< MDA		7.64
	10	< MDA	0.07	0.10	< MDA		0.13	< MDA		0.69	< MDA		0.14	< MDA		2.23
WL-117	10	< MDA	0.19	0.25	**0.30**	0.06	0.27	< MDA		1.45	**0.79**	0.24	0.23	**1.03**		0.78
	25	< MDA	0.13	0.25	< MDA		0.20	< MDA		0.94	< MDA		0.27	< MDA		2.93
WL-118	5	**1.46**	0.57	0.10	**2.40**	0.37	1.41	**28.3**	5	5.4	**18.5**	2.4	1.2	**16.1**		3.4
	10	< MDA	0.18	0.18	**0.18**	0.03	0.15	**0.90**	0.65	0.82	**0.41**	0.11	0.14	< MDA		2.42
WL-119	5	< MDA	0.17	0.27	MDA		0.15	< MDA		0.82	< MDA		0.16	< MDA		2.07
	50	< MDA	0.24	0.65	< MDA		0.12	< MDA		0.63	< MDA		0.13	< MDA		1.74
	50 DUP (L)	--		--	--		--	< MDA		0.99	< MDA		0.31	< MDA		2.71
	50 DUP (F)	< MDA	0.08	0.31	< MDA		0.13	< MDA		0.71	< MDA		0.14	< MDA		1.86
WL-120	5	**0.33**	0.23	0.24	< MDA		0.24	< MDA		1.20	< MDA		0.40	< MDA		3.20
	50	< MDA	0.12	0.12	< MDA		0.37	< MDA		1.96	< MDA		0.59	< MDA		5.06
	50 DUP (F)	< MDA	0.18	0.53	< MDA		0.25	< MDA		1.33	< MDA		0.41	< MDA		3.24
WL-121	0	0.06	0.1	0.19				<9.05		9.05	<2.78		2.78	<10.8		10.8
WL-122	0	0.09	0.08	0.12				<6.32		6.32	<1.06		1.06	<2.74		2.74
WL-123	0	**0.2**	0.13	0.13				<8.02		8.02	<1.76		1.76	<3.6		3.6
WL-124	0	**0.14**	0.08	0.07				<10.4		10.4	<2.69		2.69	<11.2		11.2
BACKGROUND SURFACE SOIL																
Barrow Pit - loess	0	**0.41**	0.29	0.28	< MDA		0.55	< MDA		3.36	< MDA		0.70	< MDA		16.53
Barrow Pit - shale	0	**0.91**	0.57	0.32	< MDA		0.56	< MDA		4.15	< MDA		0.70	< MDA		18.38
Farmer's Field	0	**0.02**	0.08	0.22	< MDA		0.77	< MDA		5.68	< MDA		1.34	< MDA		21.16
McLaren/Hart Shop	0	**0.21**	0.2	0.19	< MDA		0.73	< MDA		4.33	< MDA		0.89	< MDA		20.00

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.

* = Nuclear Regulatory Commission's Branch Technical Position (BTP) criteria for thorium-230 and radium-226, which are established at levels of background plus 5 pCi/g for surface samples and background plus 15 pCi/g for subsurface samples (15 cm depth), have been selected as reference values for comparison of all soil ananlytical data. Although this criteria is appropriate specifically for these two radionuclides, they are conservative values for comparison of all data. If no background concentration is established for a specific radionuclide, then a reference value of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples have been conservatively selected for comparison of the data.

-- = Not reported

DUP (F) = Field duplicate

DUP (L) = Laboratory duplicate

MDA = Minimum Detectable Activity

NE = Not Established

NA = Not available.

Bolded numbers indicate result reported above the minimum detectable activity.

Table B - 4 : Area 2 Soil Analytical Results - Uranium-235 Decay Series

Boring	Depth (feet)	Uranium-235/236			Uranium-235			Protactinium-231			Actinium-227			Radium-223		
		Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)		1.15			NE			NE			NE			NE		
Reference Level Concentration *																
Surface Samples		6.15			5			5			5			5		
Subsurface Samples		16.15			15			15			15			15		
AREA 2																
WL-207	5	< MDA	0.09	0.22	< MDA		1.27	< MDA		6.72	< MDA		1.76	< MDA		14.36
	5 DUP (L)	< MDA	0.12	0.24	< MDA		0.58	< MDA		3.29	< MDA		0.64	< MDA		7.47
	10	< MDA	0.01	0.25	< MDA		0.61	< MDA		3.74	< MDA		0.63	< MDA		6.46
WL-208	5	**0.16**	0.15	0.13	< MDA		1.18	< MDA		5.9	< MDA		1.22	< MDA		10.24
	5 DUP (L)	**0.03**	0.07	0.14	< MDA		1.04	< MDA		5.56	**1.40**	0.83	0.91	< MDA		7.64
	9	< MDA	0.13	0.18	< MDA		0.77	< MDA		4.40	< MDA		1.13	< MDA		7.38
WL-209	0	**251**	79	0.7	**263**	33	33	**2030**	301	160	**1320**	179	31	**1097**		98
	5	**72.4**	12.7	0.16	**74.8**	22.9	23.8	**1930**	243	122	**1180**	138	22	**900**		74
	5 DUP (F)	**115**	19	0.14	**62.6**	25.4	13.4	**1200**	161	71	**1070**	115	15	**982**		43
	25	< MDA	0.13	0.17	< MDA		0.84	< MDA		4.81	< MDA		0.86	< MDA		8.56
	25 DUP (F)	< MDA	0.08	0.12	< MDA		0.70	< MDA		3.65	< MDA		1.06	< MDA		7.65
WL-210	0	**49.7**	16.5	0.7	**182**	22	14	**838**	148	67	**732**	87	13	**660**		41
	5	**15.5**	2.9	0.17	< MDA		10.12	**348**	59	51	**220**	28	9	**171**		31
	5 DUP (F)	**43.8**	7.9	0.16	**27.2**	11.9	5.4	**164**	28	27	**156**	17	5	**147**		17
	40	< MDA	0.1	0.15	< MDA		0.78	< MDA		4.20	< MDA		1.07	< MDA		8.18
	40 DUP (F)	**0.25**	0.17	0.14	< MDA		1.50	< MDA		8.24	< MDA		1.73	< MDA		13.95
WL-211	5	**0.22**	0.15	0.13	< MDA		0.75	< MDA		5.46	**2.48**	0.72	0.87	< MDA		9.08
	25	< MDA	0.1	0.20	< MDA		0.79	< MDA		4.14	< MDA		0.88	< MDA		9.46
WL-212	5	< MDA	0.12	0.16	< MDA		1.15	< MDA		6.80	< MDA		1.38	< MDA		12.42
	10	< MDA	0.12	0.15	< MDA		0.56	< MDA		3.71	< MDA		0.78	< MDA		8.69
WL-213	0	**0.45**	0.31	0.38	< MDA		0.88	< MDA		5.11	< MDA		1.03	< MDA		18.42
	5	< MDA	0.09	0.13	< MDA		0.83	< MDA		4.84	< MDA		1.01	< MDA		9.36
	25	< MDA	0.06	0.17	< MDA		1.35	< MDA		7.02	< MDA		1.59	< MDA		15.23
WL-214	5	**0.81**	0.33	0.14	< MDA		0.52	< MDA		3.52	< MDA		0.55	< MDA		7.54
	25	< MDA	0.1	0.15	< MDA		0.89	< MDA		4.33	< MDA		0.99	< MDA		9.51
WL-215	0	**0.77**	0.54	0.72	< MDA		0.78	< MDA		4.39	< MDA		0.96	< MDA		17.02
WL-216	5	< MDA	1.13	2.36	< MDA		3.07	**39.3**	11.1	15.0	**25.8**	4.2	3.0	**30.2**		8.7
	25	< MDA	0.1	0.12	< MDA		0.61	< MDA		4.27	< MDA		0.63	< MDA		21.63
WL-217	5	< MDA	0.08	0.10	< MDA		0.53	< MDA		3.30	< MDA		0.82	< MDA		19.95
	10	< MDA	0.07	0.16	< MDA		0.60	< MDA		3.72	< MDA		0.71	< MDA		20.33
WL-218	0	**0.41**	0.3	0.23	< MDA		0.58	< MDA		3.59	< MDA		0.67	< MDA		14.84
	5	< MDA	0.08	0.13	< MDA		0.84	< MDA		5.12	< MDA		1.26	< MDA		28.83
	40	< MDA	0.06	0.13	< MDA		0.73	< MDA		4.21	< MDA		0.84	< MDA		21.50
WL-219	5	< MDA	0.1	0.11	< MDA		0.80	< MDA		5.33	< MDA		1.37	< MDA		26.48
	10	< MDA	0.23	0.41	< MDA		0.62	< MDA		3.55	< MDA		0.74	< MDA		16.44
WL-220	5	< MDA	0.003	0.11	< MDA		0.79	< MDA		4.36	< MDA		1.22	< MDA		21.37
	25	< MDA	0.08	0.18	< MDA		0.67	< MDA		4.37	< MDA		0.89	< MDA		24.86
WL-221	5	**0.19**	0.15	0.15	< MDA		0.64	< MDA		4.46	< MDA		1.06	< MDA		19.55
	35	< MDA	0.004	0.12	< MDA		0.79	< MDA		4.84	< MDA		1.13	< MDA		22.99
WL-222	0	**0.69**	0.46	0.56	< MDA		1.99	< MDA		11.4	< MDA		2.48	< MDA		44.46
	5	< MDA	0.1	0.12	< MDA		0.64	< MDA		4.19	**0.69**	0.57	0.68	< MDA		20.40
	30	< MDA	0.07	0.16	< MDA		1.22	< MDA		6.55	< MDA		1.40	< MDA		23.83
WL-223	5	< MDA	0.1	0.14	< MDA		0.75	< MDA		5.18	< MDA		1.33	< MDA		17.03
	22	< MDA	0.13	0.19	< MDA		0.60	< MDA		3.90	< MDA		0.81	< MDA		14.66
WL-224	5	< MDA	0.15	0.50	< MDA		0.71	< MDA		5.00	< MDA		1.05	< MDA		21.08
	35	< MDA	0.48	1.14	< MDA		0.69	< MDA		5.00	< MDA		0.88	< MDA		21.63
WL-225	5	< MDA	0.48	0.65	< MDA		0.75	< MDA		5.05	< MDA		0.91	< MDA		23.61
	35	< MDA	0.43	1.18	< MDA		0.93	< MDA		5.94	< MDA		1.31	< MDA		27.67
WL-226	10	**0.39**	0.34	0.36	< MDA		0.80	< MDA		5.14	< MDA		1.20	< MDA		21.54
	20	< MDA	0.66	1.19	< MDA		0.87	< MDA		7.51	< MDA		1.47	< MDA		28.91

Table B - 4 : Area 2 Soil Analytical Results - Uranium-235 Decay Series

Boring	Depth	Uranium-235/236			Uranium-235			Protactinium-231			Actinium-227			Radium-223		
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)		1.15			NE			NE			NE			NE		
Reference Level Concentration *																
Surface Samples		6.15			5			5			5			5		
Subsurface Samples		16.15			15			15			15			15		
WL-227	5	< MDA	0.4	0.63	< MDA		0.66	< MDA		3.96	< MDA		0.72	< MDA		16.05
	40	**0.36**	0.32	0.33	< MDA		0.54	< MDA		3.65	< MDA		0.58	< MDA		15.00
WL-228	5	< MDA	0.9	1.35	< MDA		0.51	< MDA	NA	4.02	< MDA	NA	0.68	< MDA		15.60
	15	< MDA	0.51	1.09	< MDA		0.75	< MDA	NA	4.35	< MDA	NA	1.11	< MDA		24.62
WL-229	5	< MDA	0.24	0.62	< MDA		0.64	< MDA	NA	3.98	< MDA	NA	0.82	< MDA		15.62
	20	< MDA	0.26	0.52	< MDA		0.64	< MDA	NA	3.98	< MDA	NA	0.91	< MDA		16.28
WL-230	5	**0.48**	0.39	0.38	< MDA		0.63	< MDA		4.86	< MDA		0.92	< MDA		17.88
	35	**1.02**	0.96	1.01	< MDA		0.69	< MDA	NA	3.85	< MDA	NA	0.97	< MDA		2.86
WL-231	0	**0.91**	0.54	0.38	< MDA		0.85	< MDA		4.76	< MDA		1.09	< MDA		18.17
	5	< MDA	1.73	3.37	< MDA		0.73	< MDA	NA	4.56	**1.86**	0.86	0.72	< MDA		19.43
	10	**0.68**	0.48	0.54	< MDA		0.79	< MDA	NA	4.85	**0.76**	0.66	0.71	< MDA		17.34
WL-233	27	< MDA	0.56	2.32	< MDA		1.02	< MDA		6.54	**1.44**		1.09	< MDA		20.81
	30	< MDA	0.95	2.30	< MDA		0.64	< MDA		4.72	< MDA		0.76	< MDA		16.06
WL-234	10	**10.9**	7.5	4.5	**774**	150	12	**1050**	169	64	**952**	108	12	**891**		39
	10 DUP (F)	**9.55**	3.37	0.62	**97.6**	11.2	7.9	**460**	78	40	**397**	46	8	**380**		24
	20	**0.43**	0.31	0.15	< MDA		0.86	< MDA		5.72	< MDA		1.34	< MDA		18.17
	20 DUP (F)	< MDA	0.06	1.23	< MDA		0.85	< MDA		5.24	< MDA		1.28	< MDA		18.16
WL-235	0	< MDA	0.15	0.49	< MDA		0.56	< MDA		3.69	< MDA		0.70	< MDA		17.28
	5	< MDA	0.36	0.92	< MDA		1.63	< MDA		8.84	< MDA		2.28	< MDA		29.14
	30	< MDA	0.16	0.30	< MDA		0.84	< MDA	NA	4.88	< MDA	NA	1.20	< MDA		15.87
WL-236	5	< MDA	0.00	0.75	< MDA		0.72	< MDA		4.94	< MDA		1.07	< MDA		14.39
	35	< MDA	0.86	1.17	< MDA		0.69	< MDA		3.94	< MDA		0.96	< MDA		14.14
WL-239	5	**0.35**	0.24	0.10	< MDA		0.35	< MDA		1.81	< MDA		0.56	< MDA		1.49
	25	< MDA	0.42	0.66	< MDA		0.25	< MDA		1.15	< MDA		0.38	< MDA		3.65
WL-241	5	**0.23**	0.20	0.23	< MDA		0.38	**4.09**	1.06	1.78	**4.22**	0.53	0.33	< MDA		5.35
	15	< MDA	0.14	0.20	< MDA		0.23	< MDA		1.15	< MDA		0.38	< MDA		3.12
WL-242	0	**0.4**	0.22	0.16	--		--	< MDA		5.12	< MDA		1.24	< MDA		31.72
	2	**0.56**	0.28	0.15	--		--	< MDA		9.23	< MDA		2.36	< MDA		52.37
WL-243	0	**0.58**	0.31	0.22	--		--	**5.22**	2.32	4.03	**3.58**	0.88	0.82	< MDA		25.10
WL-244	0	**0.09**	0.1	0.14	--		--	< MDA		4.57	**0.81**	0.45	0.73	< MDA		26.64
WL-245	0	**0.13**	0.15	0.28	--		--	< MDA		4.83	< MDA		1.32	< MDA		30.42
WL-246	0	**0.1**	0.13	0.27	--		--	< MDA		4.3	< MDA		0.91	< MDA		24.98
BACKGROUND SURFACE SOIL																
Barrow Pit - loess	0	**0.41**	0.29	0.28	< MDA		0.55	< MDA		3.36	< MDA		0.70	< MDA		16.53
Barrow Pit - shale	0	**0.91**	0.57	0.32	< MDA		0.56	< MDA		4.15	< MDA		0.70	< MDA		18.38
Farmer's Field	0	**0.02**	0.08	0.22	< MDA		0.77	< MDA		5.68	< MDA		1.34	< MDA		21.16
McLaren/Hart Shop	0	**0.21**	0.2	0.19	< MDA		0.73	< MDA		4.33	< MDA		0.89	< MDA		20.00

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.

* = Nuclear Regulatory Commission's Branch Technical Position (BTP) criteria for thorium-230 and radium-226, which are established at levels of background plus 5 pCi/g for surface samples and background plus 15 pCi/g for subsurface samples (15 cm depth), have been selected as reference values for comparison of all soil ananlytical data. Although this criteria is appropriate specifically for these two radionuclides, they are conservative values for comparison of all data. If no background concentration is established for a specific radionuclide, then a reference value of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples have been conservatively selected for comparison of the data.

-- = Not reported
DUP (F) = Field duplicate
DUP (L) = Laboratory duplicate
MDA = Minimum Detectable Activity
NE = Not Established
NA = Not available.
Bolded numbers indicate result reported above the minimum detectable activity.

Table B - 5 : Area 1 Soil Analytical Results - Thorium-232 Decay Series

Boring	Depth (feet)	Thorium-232			Radium-228			Thorium-228			Radium-224			Lead-212			Bismuth-212			Thallium 208		
		Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)			1.55			2.37			1.33			NE			2.26			NE			0.71	
Reference Level Concentration																						
Surface Samples			6.55			7.37			6.33			5			7.26			5			5.71	
Subsurface Samples			16.55			17.37			16.33			15			17.26			15			15.71	
AREA 1																						
WL-101	5	**0.89**		0.07	< MDA		0.95	**1.25**		0.13	< MDA		3.82	**0.62**	0.17	0.19	< MDA		1.29	**0.26**	0.14	0.17
	20	**1.45**	0.53	0.19	< MDA		1.08	**1.13**	0.48	0.32	**2.86**	1.81	2.15	**0.98**	0.17	0.19	< MDA		1.68	**0.31**	0.17	0.13
WL-102	5	**0.90**	0.38	0.14	< MDA		0.99	**1.05**	0.43	0.35	**3.00**	2.26	2.02	**0.97**	0.15	0.20	< MDA		1.53	< MDA		0.28
	15	**1.64**	0.56	0.2	< MDA		1.07	**0.83**	0.40	0.38	< MDA		4.49	**1.04**	0.26	0.29	< MDA		1.98	< MDA		0.33
WL-103	5	**0.78**	0.36	0.17	< MDA		1.19	**1.12**	0.46	0.32	< MDA		4.80	**0.96**	0.21	0.23	< MDA		1.89	< MDA		0.31
	10	**0.77**		0.09	< MDA		1.26	**0.30**		0.14	< MDA		3.75	**0.56**	0.31	0.33	< MDA		2.45	< MDA		0.36
WL-104	5	**0.94**	0.41	0.19	< MDA		0.84	**1.07**	0.44	0.27	< MDA		1.29	**0.61**	0.15	0.16	< MDA		1.26	**0.27**	0.11	0.13
	20	**0.77**	0.35	0.14	< MDA		0.92	**0.68**	0.34	0.34	< MDA		2.77	**0.81**	0.16	0.20	< MDA		1.65	**0.23**	0.15	0.16
WL-105	10	**4.34**	2.62	1.36	< MDA		1.59	< MDA	0.75	2.18	< MDA		11.75	< MDA		0.73	< MDA		2.82	< MDA		0.39
	30	**1.04**	0.42	0.15	< MDA		1.18	**1.02**	0.44	0.41	< MDA		4.68	**1.18**	0.22	0.19	< MDA		1.66	**0.36**	0.15	0.14
WL-106	0	**35.2**		11.2	< MDA		5.86	< MDA		7.89	**1760**	219	24	< MDA		2.90	< MDA		10.20	< MDA		1.32
	5	**3.22**		0.2	**1.42**		1.07	**0.29**		0.18	< MDA		7.30	**0.77**	0.30	0.4	< MDA		1.99	**0.42**	0.21	0.27
	5 DUP (F)	**4.71**		0.12	< MDA		2.69	**0.39**		0.11	< MDA		20.49	< MDA		1.17	**4.50**	3.61	4.16	< MDA		0.63
	25	**0.56**		0.09	< MDA		1.18	**0.55**		0.17	< MDA		1.18	**1.01**	0.20	0.19	< MDA		1.91	< MDA		0.28
	25 DUP (F)	**0.47**		0.09	< MDA		1.16	**0.5**		0.13	< MDA		5.33	**0.68**	0.35	0.37	< MDA		1.62	**0.33**	0.16	0.18
WL-107	5	**0.89**	0.34	0.09	**0.91**	0.38	0.68	**0.5**	0.24	0.18	**2.26**	2.09	2.12	**1.06**	0.18	0.19	< MDA		1.67	**0.37**	0.15	0.14
	51	**0.14**	0.12	0.09	< MDA		0.98	**0.36**	0.21	0.19	**2.34**	1.81	1.92	**0.64**	0.19	0.17	< MDA		1.84	**0.24**	0.13	0.2
	51 DUP (L)	**0.22**	0.17	0.13	< MDA		1.11	**0.17**	0.16	0.21	< MDA		3.94	**0.68**	0.18	0.23	< MDA		1.74	**0.24**	0.13	0.20
WL-108	5	**0.79**	0.32	0.12	< MDA		1.34	**0.83**	0.34	0.16	**3.32**	2.33	2.50	**0.88**	0.24	0.22	< MDA		1.84	**0.35**	0.19	0.23
WL-109	5	**0.21**	0.16	0.11	**1.18**	0.4	0.62	**0.25**	0.18	0.18	**3.15**	2.05	2.20	**1.0**	0.2	0.19	< MDA		1.82	**0.28**	0.16	0.17
	50	**0.58**	0.25	0.21	**1.36**	0.48	0.71	**0.72**	0.28	0.17	< MDA		2.34	**1.0**	0.2	0.21	< MDA		1.47	**0.28**	0.17	0.17
	50 DUP (L)	**1.13**		0.12	< MDA		1.51	**0.83**		0.11	< MDA		5.87	**0.7**	0.4	0.40	< MDA		2.29	< MDA		0.39
WL-110	5	**0.37**	0.25	0.16	< MDA		1.27	< MDA	0.13	0.23	**3.78**	2.34	2.29	**1.1**	0.23	0.20	**1.90**	1.76	1.44	**0.35**	0.21	0.21
	50	**0.87**	0.28	0.08	< MDA		1.02	**0.75**	0.26	0.14	**3.29**	2.92	2.41	**0.81**	0.22	0.21	< MDA		1.47	< MDA		0.23
WL-111	0	**0.68**	0.36	0.20	< MDA		1.05	**0.41**	0.28	0.30	< MDA		4.43	**0.97**	0.24	0.22	< MDA		1.88	**0.33**	0.14	0.19
	5	< MDA	0.39	0.70	< MDA		1.02	< MDA	0.39	0.77	< MDA		2.26	**1.10**	0.27	0.20	< MDA		1.74	**0.33**	0.19	0.18
	5 DUP (L)	--		--	< MDA		1.36	--		--	< MDA		4.38	**0.74**	0.27	0.25	< MDA		1.54	**0.31**	0.20	0.2
	51	< MDA	0.49	0.58	< MDA		1.10	< MDA	0.49	0.92	< MDA		3.17	**0.28**	0.16	0.22	< MDA		1.91	< MDA		0.21
	51 DUP (L)	--		--	< MDA		1.01	--		--	< MDA		3.57	**0.53**	0.20	0.21	< MDA		1.39	< MDA		0.21
WL-112	0	**0.84**	0.34	0.19	< MDA		1.18	**0.89**	0.36	0.19	**2.95**	1.97	2.61	**1.36**	0.26	0.23	< MDA		1.81	**0.34**	0.18	0.30
	5	< MDA	0.81	1.56	< MDA		1.20	**1.55**	1.48	1.48	< MDA		6.16	**1.08**	0.34	0.28	< MDA		2.02	**0.43**	0.27	0.21
	42	**0.68**	0.37	0.3	**1.31**	0.44	0.58	< MDA	0.38	0.58	**2.24**	1.65	2.14	**0.70**	0.20	0.19	< MDA		1.73	**0.38**	0.16	0.16
WL-113	5	**0.19**	0.11	0.08	**1.06**	0.14	0.13	**0.21**	0.12	0.11	**3.49**	0.9	0.58	**1.04**	0.14	0.05	**0.80**	0.25	0.27	**0.36**	0.06	0.04
	5 DUP (F)	**0.15**	0.11	0.08	**0.98**	0.13	0.13	< MDA	0.08	0.14	**2.86**	0.6	0.48	**1.00**	0.12	0.04	**1.06**	0.31	0.23	**0.31**	0.05	0.03
	10	**0.08**	0.07	0.08	**0.98**	0.22	0.24	**0.13**	0.09	0.1	< MDA		2.15	**0.82**	0.15	0.10	**0.90**	0.50	0.59	**0.29**	0.08	0.06
WL-114	0	**18.1**	4.6	0.78	< MDA		2.50	**1.96**	1.14	0.99	< MDA		12.42	< MDA		1.85	< MDA		3.90	**0.79**	0.83	0.51
	5	< MDA	0.22	0.26	**0.39**	0.12	0.16	**0.33**	0.25	0.26	**6.15**	1.05	0.68	**0.43**	0.08	0.06	< MDA		0.35	**0.16**	0.05	0.04
	5 DUP (L)	--		--	**0.46**	0.12	0.15	--		--	**5.59**	1	0.08	**0.48**	0.09	0.07	**0.35**	0.22	0.27	**0.16**	0.05	0.04
	15	< MDA	0.14	0.2	**1.04**	0.15	0.14	**0.35**	0.25	0.27	**3.14**	0.92	0.65	**0.99**	0.13	0.06	**0.84**	0.35	0.30	**0.35**	0.05	0.04
	15 DUP (L)	--		--	**1.08**	0.17	0.15	--		--	**2.71**	0.89	0.77	**1.01**	0.13	0.07	< MDA		1.39	**0.35**	0.06	0.04
WL-115	5	**0.21**	0.13	0.11	**0.93**	0.13	0.12	**0.32**	0.16	0.14	**3.02**	0.76	0.50	**0.81**	0.11	0.04	**0.50**	0.31	0.27	**0.29**	0.29	0.03
	40	**0.27**	0.15	0.09	**0.69**	0.1	0.10	**0.19**	0.12	0.05	**1.80**	0.49	0.042	**0.70**	0.07	0.04	**0.57**	0.22	0.20	**0.19**	0.19	0.03
WL-116	0	**0.52**	0.34	0.46	< MDA		1.19	**0.54**	0.33	0.39	< MDA		5.22	**0.73**	0.38	0.31	< MDA		1.54	**0.35**	0.18	0.15
	5	**0.25**	0.14	0.04	**0.94**	0.13	0.14	**0.39**	0.18	0.07	**2.93**	0.67	0.52	**0.89**	0.11	0.05	**0.64**	0.33	0.29	**0.3**	0.06	0.04
	5 DUP (F)	**0.21**	0.13	0.07	**1.0**	0.2	0.28	**0.33**	0.17	0.12	< MDA		2.26	**1.02**	0.17	0.10	**0.89**	0.59	0.61	**0.37**	0.09	0.07
	10	**0.33**	0.18	0.13	**0.76**	0.11	0.11	**0.25**	0.16	0.14	**2.74**	0.66	0.40	**0.71**	0.09	0.04	**0.44**	0.19	0.19	**0.24**	0.04	0.03
WL-117	10	**1**	0.35	0.12	**0.64**	0.14	0.16	**0.47**	0.22	0.18	**6.48**	1.12	0.71	**0.58**	0.09	0.06	< MDA		0.40	**0.16**	0.05	0.04
	25	**0.2**	0.14	0.12	**0.64**	0.12	0.12	**0.39**	0.2	0.16	**1.92**	0.71	0.52	**0.59**	0.09	0.05	**0.64**	0.25	0.21	**0.18**	0.05	0.03
WL-118	5	**10.3**	3.5	2.22	< MDA		0.73	MDA	1.4	1.99	**39.1**	6.3	3.6	< MDA		0.55	< MDA		1.33	< MDA		0.17
	10	**0.35**	0.23	0.2	**0.49**	0.09	0.14	**0.34**	0.23	0.23	**0.47**	0.55	0.43	**0.49**	0.07	0.04	**0.39**	0.23	0.23	**0.17**	0.04	0.03
WL-119	5	**0.26**	0.17	0.13	**0.73**	0.12	0.12	**0.3**	0.19	0.2	**2.68**	0.75	0.48	**0.79**	0.1	0.04	< MDA		0.34	**0.29**	0.05	0.03
	50	< MDA	0.26	0.41	**0.41**	0.09	0.10	MDA	0.17	0.3	**1.77**	0.45	0.34	**0.51**	0.05	0.03	**0.42**	0.2	0.20	**0.15**	0.03	0.02
	50 DUP (L)	--		--	**0.44**	0.1	0.12	-		-	**1.83**	0.72	0.55	**0.49**	0.07	0.05	< MDA		0.25	**0.13**	0.04	0.03
	50 DUP (F)	**0.1**	0.08	0.09	**0.50**	0.10	0.12	**0.15**	0.1	0.09	**1.66**	0.57	0.39	**0.47**	0.06	0.03	**0.33**	0.29	0.23	**0.17**	0.04	0.03

Table B - 5 : Area I Soil Analytical Results - Thorium-232 Decay Series

Boring	Depth (feet)	Thorium-232 Result	Thorium-232 +/- Sigma	Thorium-232 MDA	Radium-228 Result	Radium-228 +/- Sigma	Radium-228 MDA
Site Specific Background(Mean+2 Std Dev)		**1.55**			**2.37**		
Reference Level Concentration *							
Surface Samples		**6.55**			**7.37**		
Subsurface Samples		**16.55**			**17.37**		
WL-120	5	**0.14**	0.09	0.09	**1.08**	0.15	0.16
	50	**0.23**	0.16	0.13	**0.91**	0.21	0.22
	50 DUP (F)	**0.25**	0.15	0.15	**1.04**	0.18	0.17
WL-121	0	**0.87**	0.23	0.09	<2.14		2.14
WL-122	0	**1.02**	0.26	0.1	<1.69		1.69
WL-123	0	**1.06**	0.27	0.05	<1.82		1.82
WL-124	0	**1.16**	0.3	0.07	<1.79		1.79
BACKGROUND SURFACE SOIL							
Barrow Pit - loess	0	**0.75**	0.38	0.22	**1.39**	0.4	0.64
Barrow Pit - shale	0	**1.26**	0.39	0.14	**1.90**	0.47	0.64
Farmer's Field	0	**1.05**	0.38	0.1	< MDA		1.14
McLaren/Hart Shop	0	**0.52**	0.29	0.18	< MDA		1.24

Boring	Depth (feet)	Thorium-228 Result	Thorium-228 +/- Sigma	Thorium-228 MDA	Radium-224 Result	Radium-224 +/- Sigma	Radium-224 MDA
Site Specific Background(Mean+2 Std Dev)		**1.33**			**NE**		
Reference Level Concentration *							
Surface Samples		**6.33**			**5**		
Subsurface Samples		**16.33**			**15**		
WL-120	5	**0.26**	0.12	0.08	**3.11**	0.95	0.65
	50	< MDA	0.15	0.2	< MDA		1.96
	50 DUP (F)	**0.26**	0.15	0.13	**3.07**	0.94	0.67
WL-121	0	**1.2**	0.29	0.17			
WL-122	0	**1.11**	0.28	0.08			
WL-123	0	**0.88**	0.24	0.12			
WL-124	0	**1.17**	0.31	0.12			
BACKGROUND SURFACE SOIL							
Barrow Pit - loess	0	**0.58**	0.34	0.33	< MDA		2.99
Barrow Pit - shale	0	**1.16**	0.37	0.13	< MDA		3.54
Farmer's Field	0	**0.56**	0.26	0.20	< MDA		5.03
McLaren/Hart Shop	0	**0.43**	0.27	0.24	< MDA		3.85

Boring	Depth (feet)	Lead-212 Result	Lead-212 +/- Sigma	Lead-212 MDA	Bismuth-212 Result	Bismuth-212 +/- Sigma	Bismuth-212 MDA
Site Specific Background(Mean+2 Std Dev)		**2.26**			**NE**		
Reference Level Concentration *							
Surface Samples		**7.26**			**5**		
Subsurface Samples		**17.26**			**15**		
WL-120	5	**1.01**	0.14	0.06	**0.88**	0.37	0.34
	50	**1.12**	0.15	0.08	< MDA		0.64
	50 DUP (F)	**1.00**	0.14	0.06	**0.75**	0.32	0.39
WL-121	0	**1.1**	0.4	0.46	<4.94		4.94
WL-122	0	**1.19**	0.37	0.26	<5.64		5.64
WL-123	0	**0.81**	0.45	0.49	<5.84		5.84
WL-124	0	<0.95		0.95	<5.48		5.48
BACKGROUND SURFACE SOIL							
Barrow Pit - loess	0	**1.33**	0.21	0.18	< MDA		1.71
Barrow Pit - shale	0	**1.94**	0.29	0.23	< MDA		1.61
Farmer's Field	0	**0.80**	0.31	0.36	< MDA		2.17
McLaren/Hart Shop	0	**1.09**	0.26	0.21	< MDA		1.75

Boring	Depth (feet)	Thallium 208 Result	Thallium 208 +/- Sigma	Thallium 208 MDA
Site Specific Background(Mean+2 Std Dev)		**0.71**		
Reference Level Concentration *				
Surface Samples		**5.71**		
Subsurface Samples		**15.71**		
WL-120	5	< MDA		0.04
	50	**0.32**	0.07	0.07
	50 DUP (F)	**0.33**	0.06	0.04
WL-121	0	<0.53		0.53
WL-122	0	**0.59**	0.23	0.17
WL-123	0	<0.51		0.51
WL-124	0	<0.53		0.53
BACKGROUND SURFACE SOIL				
Barrow Pit - loess	0	**0.38**	0.16	0.16
Barrow Pit - shale	0	**0.63**	0.21	0.18
Farmer's Field	0	**0.32**	0.16	0.22
McLaren/Hart Shop	0	**0.41**	0.16	0.18

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.
* = Nuclear Regulatory Commission's Branch Technical Position (BTP) criteria for thorium-230 and radium-226, which are established at levels of background plus 5 pCi/g for surface samples and background plus 15 pCi/g for subsurface samples (15 cm depth), have been selected as reference values for comparison of all soil ananlytical data. Although this criteria is appropriate specifically for these two radionuclides, they are conservative values for comparison of all data. If no background concentration is established for a specific radionuclide, then a reference value of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples have been conservatively selected for comparison of the data.
-- = Not reported
DUP (F) = Field duplicate
DUP (L) = Laboratory duplicate
MDA = Minimum Detectable Activity
NE = Not established
NA = Not available.
Bolded numbers indicate result reported above minimum detectable activity

Table B - 6 : Area 2 Soil Analytical Results - Thorium-232 Decay Series

Boring	Depth (feet)	Thorium-232			Radium-228			Thorium-228			Radium-224			Lead-212			Bismuth-212			Thallium 208		
		Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)		1.55			2.37			1.33			NE			2.26			NE			0.71		
Reference Level Concentration																						
Surface Samples		**6.55**			**7.37**			**6.33**			**5**			**7.26**			**5**			**5.71**		
Subsurface Samples		**16.55**			**17.37**			**16.33**			**15**			**17.26**			**15**			**15.71**		
AREA 2																						
WL-207	5	**1.42**	0.75	*0.39*	< MDA		*1.59*	< MDA	*0.52*	*0.77*	MDA		*6.13*	**1.77**	0.48	*0.36*	< MDA		*2.86*	< MDA		*0.32*
	5 DUP (L)	**1.92**	1.16	*0.59*	< MDA		*0.97*	< MDA	*0.6*	*1.44*	**2.90**	1.77	*2.05*	**1.06**	0.17	*0.18*	< MDA		*1.40*	**0.34**	0.16	*0.17*
	10	**1.37**	1.22	*1.17*	< MDA		*1.10*	< MDA	*1.09*	*1.96*	**3.11**	2.55	*1.90*	**1.11**	0.16	*0.17*	MDA		*1.14*	< MDA		*0.25*
WL-208	5	**1.43**	0.42	*0.08*	**0.68**	0.46	*0.66*	**0.96**	0.32	*0.16*	< MDA		*5.15*	**0.48**	0.26	*0.25*	< MDA		*1.23*	< MDA		*0.27*
	5 DUP (L)	**0.82**	0.32	*0.14*	MDA		*1.03*	**0.7**	0.3	*0.24*	< MDA		*4.77*	**0.84**	0.25	*0.24*	< MDA		*1.75*	**0.38**	0.18	*0.22*
	9	**0.36**	0.16	*0.07*	< MDA		*0.74*	**0.36**	0.17	*0.12*	**3.05**	2.36	*2.25*	**0.63**	0.2	*0.20*	< MDA		*1.46*	**0.22**	0.13	*0.13*
WL-209	0	**127**	23	*0.09*	MDA		*21.34*	**4.97**	1.04	*0.09*	**6580**	1090	*95*	< MDA		*13.80*	< MDA		*40.36*	< MDA		*5.77*
	5	**138**	60	*32.2*	< MDA		*16.34*	< MDA	*10.4*	*40.1*	< MDA		*123.9*	< MDA		*8.56*	< MDA		*30.10*	< MDA		*4.28*
	5 DUP (F)	**180**	65	*20.2*	**16.7**	9.3	*11.3*	< MDA	*34.1*	*61.7*	< MDA		*93.04*	< MDA		*3.83*	< MDA		*20.68*	**4.27**	1.71	*2.53*
	25	**0.71**	0.27	*0.05*	< MDA		*0.92*	**0.38**	0.21	*0.25*	< MDA		*3.79*	**0.52**	0.23	*0.25*	< MDA		*1.41*	**0.22**	0.12	*0.15*
	25 DUP (F)	< MDA	*0.53*	*0.84*	< MDA		*0.85*	< MDA	*0.61*	*1.26*	**2.68**	2.27	*2.26*	**0.52**	0.18	*0.20*	< MDA		*1.15*	**0.19**	0.19	*0.12*
WL-210	0	**59.2**	23.2	*17.5*	< MDA		*9.55*	< MDA	*8.6*	*13.5*	**4330**	628	*39*	< MDA		*4.70*	< MDA		*17.29*	< MDA		*2.34*
	5	**106**	19	*0.06*	< MDA		*6.72*	**3.88**	0.78	*0.08*	< MDA		*0.52*	< MDA		*3.64*	< MDA		*12.76*	< MDA		*1.78*
	5 DUP (F)	**120**	21	*0.06*	< MDA		*4.66*	**4.59**	0.91	*0.05*	< MDA		*36.13*	**2.49**	0.94	*1.35*	< MDA		*7.93*	**1.13**	0.78	*1.06*
	40	**0.37**	0.17	*0.08*	< MDA		*0.83*	**0.65**	0.24	*0.16*	**3.00**	1.85	*2.12*	**0.61**	0.16	*0.19*	< MDA		*1.19*	< MDA		*0.15*
	40 DUP (F)	**0.82**	0.28	*0.07*	< MDA		*1.45*	**0.40**	0.18	*0.11*	< MDA		*5.84*	**0.43**	0.43	*0.41*	< MDA		*2.27*	< MDA		*0.40*
WL-211	5	**1.38**	0.35	*0.08*	< MDA		*1.15*	**0.66**	0.21	*0.08*	< MDA		*5.48*	**0.99**	0.25	*0.23*	< MDA		*1.73*	< MDA		*0.21*
	25	**0.32**	0.16	*0.08*	< MDA		*0.85*	**0.29**	0.17	*0.2*	< MDA		*3.51*	< MDA		*0.33*	< MDA		*1.47*	< MDA		*0.21*
WL-212	5	**0.29**	0.14	*0.08*	< MDA		*1.16*	**0.33**	0.16	*0.14*	**7.26**	5.14	*3.87*	< MDA		*0.46*	< MDA		*2.19*	< MDA		*0.37*
	10	**0.9**	0.29	*0.13*	< MDA		*0.90*	**0.55**	0.22	*0.17*	**3.66**	1.73	*2.31*	**0.47**	0.16	*0.24*	< MDA		*1.60*	< MDA		*0.16*
WL-213	0	**1.11**	0.41	*0.20*	< MDA		*0.90*	**0.79**	0.34	*0.22*	< MDA		*4.09*	< MDA		*0.37*	< MDA		*1.54*	< MDA		*0.22*
	5	**0.89**	0.3	*0.15*	MDA		*0.92*	**0.67**	0.25	*0.15*	< MDA		*4.14*	**0.63**	0.25	*0.27*	< MDA		*1.48*	< MDA		*1.65*
	25	**0.52**	0.21	*0.07*	< MDA		*1.49*	**0.64**	0.24	*0.1*	< MDA		*5.23*	< MDA		*0.40*	< MDA		*2.76*	**0.37**	0.22	*0.29*
WL-214	5	**0.41**	0.2	*0.14*	< MDA		*0.81*	**0.5**	0.23	*0.2*	< MDA		*2.31*	**0.62**	0.16	*0.21*	< MDA		*1.34*	**0.24**	0.12	*0.17*
	25	**0.36**	0.19	*0.12*	< MDA		*0.89*	**0.48**	0.24	*0.22*	< MDA		*4.23*	**0.80**	0.31	*0.22*	< MDA		*1.37*	**0.32**	0.16	*0.18*
WL-215	0	**0.31**	0.15	*0.07*	< MDA		*0.73*	**0.27**	0.14	*0.12*	**3.04**	2.23	*2.41*	**0.41**	0.18	*0.21*	< MDA		*1.37*	< MDA		*0.21*
WL-216	5	**3.05**	1.45	*0.81*	< MDA		*2.21*	< MDA	*0.45*	*1.14*	< MDA		*18.28*	< MDA		*1.07*	< MDA		*4.26*	< MDA		*0.55*
	25	**1.17**	0.39	*0.1*	**1.62**	0.44	*0.54*	**0.92**	0.34	*0.16*	< MDA		*2.08*	**0.81**	0.21	*0.19*	< MDA		*1.34*	**0.42**	0.18	*0.18*
WL-217	5	< MDA	*0.005*	*0.085*	< MDA		*0.81*	< MDA	*0.04*	*0.15*	MDA		*2.83*	< MDA		*0.23*	< MDA		*1.26*	< MDA		*0.19*
	10	**0.72**	0.31	*0.11*	< MDA		*1.04*	**0.84**	0.34	*0.18*	**2.57**	2.29	*1.94*	**1.05**	0.19	*0.17*	< MDA		*1.36*	**0.32**	0.15	*0.16*
WL-218	0	**0.77**	0.32	*0.07*	**0.82**	0.38	*0.66*	**0.72**	0.31	*0.11*	< MDA		*2.64*	**0.75**	0.18	*0.19*	< MDA		*1.57*	**0.36**	0.13	*0.14*
	5	**0.67**	0.3	*0.12*	**1.01**	0.48	*0.70*	**0.82**	0.34	*0.19*	< MDA		*3.90*	**0.57**	0.28	*0.34*	< MDA		*1.79*	< MDA		*0.17*
	40	**0.58**	0.25	*0.09*	< MDA		*1.16*	**0.86**	0.32	*0.14*	< MDA		*3.73*	**1.20**	0.22	*0.22*	< MDA		*1.85*	< MDA		*0.29*
WL-219	5	**1.12**	0.42	*0.14*	**1.17**	0.59	*0.77*	**0.98**	0.38	*0.14*	< MDA		*2.76*	**1.09**	0.24	*0.24*	< MDA		*1.84*	**0.42**	0.21	*0.21*
	10	**0.44**	0.2	*0.07*	< MDA		*1.04*	**0.37**	0.18	*0.13*	< MDA		*3.23*	**0.55**	0.18	*0.18*	< MDA		*1.79*	< MDA		*0.27*
WL-220	5	**0.69**	0.27	*0.10*	< MDA		*1.22*	**0.51**	0.24	*0.26*	< MDA		*4.47*	**0.56**	0.22	*0.33*	< MDA		*1.79*	< MDA		*0.28*
	25	**0.22**	0.16	*0.1*	**1.25**	0.38	*0.56*	**0.18**	0.15	*0.18*	< MDA		*3.72*	**0.92**	0.22	*0.24*	< MDA		*1.39*	**0.44**	0.21	*0.17*
WL-221	5	**0.7**	0.28	*0.24*	< MDA		*1.12*	**0.58**	0.25	*0.22*	< MDA		*2.54*	**0.76**	0.19	*0.22*	< MDA		*1.61*	< MDA		*0.28*
	35	**0.63**	0.27	*0.14*	< MDA		*1.09*	**0.41**	0.22	*0.15*	< MDA		*4.15*	**0.59**	0.33	*0.24*	< MDA		*1.85*	**0.21**	0.19	*0.18*
WL-222	0	**1.31**	0.40	*0.2*	< MDA		*1.75*	**0.97**	0.32	*0.16*	< MDA		*8.22*	< MDA		*0.53*	< MDA		*2.91*	< MDA		*0.45*
	5	**1.3**	0.38	*0.17*	**0.83**	0.44	*0.70*	**0.89**	0.3	*0.12*	**4.71**	1.95	*2.07*	**0.78**	0.2	*0.18*	< MDA		*1.73*	< MDA		*0.16*
	30	**1.0**	0.3	*0.15*	< MDA		*1.27*	**0.78**	0.29	*0.12*	< MDA		*5.00*	< MDA		*0.48*	< MDA		*2.39*	< MDA		*0.39*
WL-223	5	**0.64**	0.3	*0.12*	< MDA		*1.14*	**0.36**	0.22	*0.19*	< MDA		*4.57*	**0.83**	0.28	*0.31*	< MDA		*1.64*	**0.31**	0.19	*0.22*
	22	**0.18**	0.13	*0.1*	< MDA		*0.88*	< MDA	*0.1*	*0.16*	MDA		*3.07*	**0.61**	0.17	*0.22*	< MDA		*1.62*	**0.31**	0.15	*0.14*
WL-224	5	< MDA	*0.49*	*0.91*	**1.23**	0.47	*0.67*	< MDA	*0.65*	*1.37*	< MDA		*2.16*	**1.17**	0.23	*0.19*	**1.86**	1.28	*1.81*	**0.35**	0.19	*0.23*
	35	< MDA	*0.42*	*0.62*	**1.19**	0.41	*0.90*	< MDA	*0.43*	*0.97*	**2.21**	1.75	*2.12*	**0.95**	0.2	*0.19*	< MDA		*1.93*	**0.49**	0.23	*0.16*
WL-225	5	**1.76**	1.07	*0.62*	< MDA		*1.18*	< MDA	*0.42*	*0.84*	**2.84**	2.40	*2.23*	**1.06**	0.23	*0.20*	< MDA		*2.39*	**0.50**	0.16	*0.19*
	35	**0.33**	0.17	*0.16*	< MDA		*1.50*	**0.48**	0.21	*0.17*	< MDA		*5.32*	**0.49**	0.21	*0.29*	< MDA		*2.10*	**0.29**	0.24	*0.26*
WL-226	10	< MDA	*0.51*	*0.85*	**0.95**	0.46	*0.82*	< MDA	*0.81*	*1.12*	< MDA		*4.52*	**1.38**	0.27	*0.27*	< MDA		*1.85*	**0.30**	0.21	*0.19*
	20	< MDA	*0.68*	*0.85*	MDA		*1.12*	< MDA	*0.69*	*0.99*	< MDA		*5.32*	< MDA		*0.39*	< MDA		*2.05*	< MDA		*0.25*
WL-227	5	< MDA	*0.52*	*0.53*	**1.35**	0.43	*0.73*	MDA	*0.64*	*0.84*	**3.48**	1.66	*2.10*	**1.03**	0.2	*0.23*	< MDA		*1.76*	**0.23**	0.11	*0.18*
	40	< MDA	*0.53*	*0.55*	< MDA		*0.79*	MDA	*0.38*	*0.74*	MDA		*2.39*	**0.67**	0.16	*0.15*	< MDA		*1.55*	**0.19**	0.17	*0.13*
WL-228	5	< MDA	*0.34*	*0.79*	**1.29**	0.41	*0.62*	< MDA	*0.55*	*1.04*	**3.64**	2.68	*2.13*	**0.98**	0.18	*0.19*	< MDA		*1.55*	**0.38**	0.20	*0.17*
	15	**0.62**	0.39	*0.37*	MDA		*1.12*	**1.01**	0.54	*0.65*	MDA		*4.05*	**0.78**	0.21	*0.27*	< MDA		*1.76*	< MDA		*0.19*
WL-229	5	**1.47**	0.97	*0.89*	MDA		*1.24*	**1.5**	0.80	*0.8*	**3.30**	1.87	*2.23*	**1.16**	0.20	*0.20*	< MDA		*1.89*	**0.45**	0.21	*0.15*
	20	MDA	*0.58*	*0.69*	MDA		*0.96*	< MDA	*0.66*	*1.02*	MDA		*3.19*	**0.54**	0.18	*0.19*	MDA		*1.79*	< MDA		*0.21*

Table B - 6 : Area 2 Soil Analytical Results - Thorium-232 Decay Series

Boring	Depth	Thorium-232			Radium-228			Thorium-228			Radium-224			Lead-212			Bismuth-212			Thallium 208		
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)		**1.55**			**2.37**			**1.33**			**NE**			**2.26**			**NE**			**0.71**		
Reference Level Concentration																						
Surface Samples		**6.55**			**7.37**			**6.33**			**5**			**7.26**			**5**			**5.71**		
Subsurface Samples		**16.55**			**17.37**			**16.33**			**15**			**17.26**			**15**			**15.71**		
WL-230	5	< MDA	0.63	0.87	< MDA		1.16	< MDA	0.52	1.29	< MDA		3.92	**0.88**	0.21	0.19	< MDA		2.00	**0.31**	0.18	0.19
	35	< MDA	0.29	0.75	< MDA		0.89	< MDA	0.42	1.17	< MDA		3.32	**0.49**	0.16	0.25	< MDA		1.75	< MDA		0.25
WL-231	0	< MDA	0.1	0.19	< MDA		0.92	< MDA	0.01	0.14	**3.21**	2.21	2.32	**0.35**	0.2	0.20	< MDA		1.26	< MDA		0.16
	5	**1.11**	0.85	0.83	< MDA		1.02	< MDA	0.43	1.26	< MDA		3.95	**0.70**	0.20	0.19	< MDA		1.60	< MDA		0.28
	10	< MDA	0.28	0.87	< MDA		0.75	< MDA	0.40	0.99	**2.23**	1.77	2.21	**0.42**	0.16	0.19	< MDA		1.48	< MDA		0.24
WL-233	27	**1.19**	0.83	0.56	< MDA		1.11	< MDA	0.73	1.02	**7.35**	3.04	3.32	< MDA		2.87	< MDA		1.80	< MDA		0.24
	30	**0.82**	0.64	0.49	< MDA		1.05	< MDA	0.64	1.02	< MDA		3.11	**0.39**	0.16	0.20	< MDA		1.64	< MDA		0.23
WL-234	10	< MDA	173	240	**14.5**	7.9	10.3	< MDA	4.5	196	< MDA		87.47	**10.8**	2.7	3.2	< MDA		18.63	**3.09**	1.79	2.26
	10 DUP (F)	< MDA	84.6	98.7	< MDA		6.62	< MDA	2.6	132	< MDA		56.24	< MDA		2.19	< MDA		11.82	< MDA		1.51
	20	**0.67**	0.23	0.07	< MDA		1.25	**0.65**	0.23	0.12	< MDA		4.56	**0.75**	0.26	0.24	< MDA		1.98	**0.25**	0.22	0.22
	20 DUP (F)	**0.85**	0.43	0.38	< MDA		1.23	**0.75**	0.41	0.38	< MDA		2.58	**1.04**	0.22	0.23	< MDA		1.89	**0.25**	0.18	0.21
WL-235	0	**1.03**	0.31	0.10	**1.19**	0.45	0.56	**0.60**	0.22	0.13	**3.40**	1.81	2.02	**1.09**	0.18	0.18	< MDA		1.76	**0.46**	0.18	0.16
	5	< MDA	0.38	0.83	< MDA		1.58	**1.2**	0.86	0.94	< MDA		7.20	**1.10**	0.57	0.41	< MDA		2.99	**0.60**	0.28	0.28
	30	< MDA	0.28	0.94	< MDA		0.93	< MDA	0.47	0.87	**3.11**	2.70	2.58	**0.75**	0.21	0.23	< MDA		1.68	< MDA		0.28
WL-236	5	< MDA	0.46	0.69	< MDA		1.00	**1.25**	0.58	0.56	**3.84**	2.28	2.57	**1.10**	0.20	0.23	**1.70**	1.16	1.57	**0.45**	0.16	0.19
	35	< MDA	0.63	1.02	< MDA		1.23	< MDA	0.39	0.73	< MDA		4.01	**0.95**	0.24	0.27	< MDA		1.84	**0.29**	0.25	0.17
WL-239	5	**0.26**	0.13	0.07	**1.13**	0.19	0.17	**0.23**	0.13	0.12	< MDA		1.80	**1.11**	0.17	0.09	< MDA		0.55	**0.31**	0.07	0.06
	25	**0.31**	0.17	0.14	**0.72**	0.13	0.12	**0.17**	0.13	0.15	**2.48**	0.67	0.67	**0.67**	0.10	0.06	**0.67**	0.31	0.27	**0.18**	0.04	0.03
WL-241	5	**3.84**	0.9	0.05	< MDA		0.24	**0.39**	0.2	0.23	< MDA		2.14	< MDA		0.88	< MDA		0.42	**0.28**	0.06	0.06
	15	**0.18**	0.11	0.08	**0.96**	0.16	0.16	**0.15**	0.1	0.08	**3.61**	1	0.066	**1.00**	0.13	0.06	< MDA		0.41	**0.35**	0.06	0.04
WL-242	0	< MDA		0.34	< MDA		0.77	< MDA	0.45	1.1	< MDA		4.25	< MDA		0.28	< MDA		1.63	< MDA		0.24
	2	< MDA	0.58	0.75	< MDA		1.57	< MDA	0.3	1.19	< MDA		7.62	**0.51**	0.43	0.51	< MDA		2.73	< MDA		0.43
WL-243	0	**6.73**	1.36	0.15	**1.13**	0.54	0.84	**1.11**	0.35	0.15	< MDA		4.33	**1.04**	0.25	0.22	< MDA		1.80	**0.46**	0.18	0.15
WL-244	0	**0.78**	0.68	0.65	< MDA		1.05	< MDA	0.74	1.23	< MDA		2.24	**0.86**	0.21	0.2	< MDA		1.43	**0.23**	0.16	0.17
WL-245	0	**0.38**	0.2	0.11	< MDA		1.20	**0.58**	0.26	0.16	< MDA		5.06	**1.18**	0.38	0.25	< MDA		2.11	**0.5**	0.2	0.23
WL-246	0	**0.63**	0.31	0.15	< MDA		1.07	**0.62**	0.31	0.2	< MDA		2.70	**1.05**	0.22	0.24	< MDA		1.85	**0.34**	0.17	0.2
BACKGROUND SURFACE SOIL																						
Barrow Pit - loess	0	**0.75**	0.38	0.22	**1.39**	0.4	0.64	**0.58**	0.34	0.33	< MDA		2.99	**1.33**	0.21	0.18	< MDA		1.71	**0.38**	0.16	0.16
Barrow Pit - shale	0	**1.26**	0.39	0.14	**1.90**	0.47	0.64	**1.16**	0.37	0.13	< MDA		3.54	**1.94**	0.29	0.23	< MDA		1.61	**0.63**	0.21	0.18
Farmer's Field	0	**1.05**	0.38	0.1	< MDA		1.14	**0.56**	0.26	0.20	< MDA		5.03	**0.80**	0.31	0.36	< MDA		2.17	**0.32**	0.16	0.22
McLaren/Hart Shop	0	**0.52**	0.29	0.18	< MDA		1.24	**0.43**	0.27	0.24	< MDA		3.85	**1.09**	0.26	0.21	< MDA		1.75	**0.41**	0.16	0.18

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.
* = Nuclear Regulatory Commission's Branch Technical Position (BTP) criteria for thorium-230 and radium-226, which are established at levels of background plus 5 pCi/g for surface samples and background plus 15 pCi/g for subsurface samples (15 cm depth), have been selected as reference values for comparison of all soil ananlytical data. Although this criteria is appropriate specifically for these two radionuclides, they are conservative values for comparison of all data. If no background concentration is established for a specific radionuclide, then a reference value of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples have been conservatively selected for comparison of the data.
-- = Not reported
DUP (F) = Field duplicate
DUP (L) = Laboratory duplicate
MDA = Minimum Detectable Activity
NE = Not established
NA = Not available.
Bolded numbers indicate result reported above minimum detectable activity

Table B -7 : Ford Property Soil Analytical Results - U-238 Decay Series

Boring	Depth (feet)	Uranium-238			Uranium-234			Thorium-230			Radium-226			Lead-214			Bismuth-214			Lead-210		
		Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)		**2.24**			**2.73**			**2.45**			**1.30**			**1.13**			**1.61**			**3.77**		
Reference Level Concentration																						
Surface Samples		**7.24**			**7.73**			**7.45**			**6.3**			**6.13**			**6.61**			**8.77**		
Subsurface Samples		**17.24**			**17.73**			**17.45**			**16.3**			**16.13**			**16.61**			**18.77**		
FP1 0-3	0.25	**0.81**	0.21	0.09	**0.73**	0.19	0.08	**12.8**	2.8	0.2	7.23		7.23	<0.98		0.98	<1.25		1.25	<1460		1460
FP1 0-3	0.25	**0.8**	0.19	0.06	**0.84**	0.2	0.07	**1.39**	0.33	0.06	**7.19**	3.98	4.63	**1.68**	0.55	0.47	<1.00		1	<4.47		4.47
FP1 12-24	2	**0.75**	0.19	0.06	**0.69**	0.18	0.04	**1.16**	0.29	0.06	<4.94		4.94	**0.73**	0.41	0.36	<1.14		1.14	<3.83		3.83
FP2 0-3	0.25	**1.17**	0.26	0.09	**1.08**	0.24	0.07	**2.92**	0.63	0.1	<6.28		6.28	**0.75**	0.65	0.55	<1.27		1.27	**4.96**	4.05	3.15
FP2 12-24	2	**0.94**	0.24	0.1	**0.78**	0.21	0.1	**1.24**	0.31	0.12	**7.99**	4.85	4.93	<1.22		1.22	<1.29		1.29	<3.66		3.66
FP3 0-3	0.25	**0.79**	0.2	0.05	**0.69**	0.18	0.07	**1.26**	0.31	0.11	<6.23		6.23	<0.89		0.89	<1.11		1.11	<4.30		4.3
FP3 12-24	2	**2.62**	0.51	0.07	**1.94**	0.4	0.07	**1.26**	0.31	0.07	<4.24		4.24	**1.03**	0.4	0.36	<1.01		1.01	<3.19		3.19
FP4 0-3	0.25	**0.96**	0.23	0.03	**1.01**	0.23	0.04	**2.61**	0.57	0.07	**9.06**	3.81	3.62	**1**	0.69	0.62	<1.20		1.2	**4.35**	3.5	2.81
FP4 12-24	2	**0.84**	0.21	0.06	**0.71**	0.19	0.06	**2.2**	0.49	0.07	<5.58		5.58	**1.13**	0.51	0.55	<1.28		1.28	**3.97**	3.27	3.97
FP5 0-3	0.25	**1.05**	0.23	0.04	**0.84**	0.2	0.05	**28.6**	5.2	0.08	**4.08**	3.1	2.99	**1.54**	0.42	0.29	<0.65		0.65	<811		811
FP5 12-24	2	**1.2**	0.33	0.09	**1.11**	0.32	0.08	**5.31**	1.03	0.09	<6.04		6.04	**1.07**	0.44	0.56	<1.05		1.05	**4.62**	2.82	3.34
FP6 0-3	0.25	**0.91**	0.21	0.06	**0.73**	0.18	0.07	**1.2**	0.29	0.06	<5.59		5.59	**0.82**	0.42	0.49	<1.25		1.25	<2.78		2.78
FP6 12-24	2	**1.07**	0.25	0.05	**0.86**	0.21	0.04	**1.8**	0.39	0.05	<3.25		3.25	<0.92		0.92	<0.96		0.96	<3.73		3.73
FP7 0-3	0.25	**0.82**	0.25	0.07	**0.88**	0.26	0.06	**2.08**	0.43	0.07	**4.72**	2.89	3.49	**0.85**	0.45	0.44	<0.89		0.89	<3.22		3.22
FP7 12-24	2	**0.71**	0.26	0.13	**0.65**	0.25	0.15	**1.51**	0.32	0.03	<6.63		6.63	**1.12**	0.5	0.46	<0.95		0.95	<3.98		3.98
FP8 0-3	0.25	**0.81**	0.25	0.08	**0.95**	0.28	0.06	**21.8**	3.8	0.09	<5.22		5.22	**1.49**	0.54	0.43	<1.15		1.15	**4.96**	2.62	2.27
FP8 1-2	2	**1.3**	0.42	0.24	**0.93**	0.34	0.21	**2.04**	0.42	0.082	<5.78		5.78	**1.59**	0.52	0.56	<1.37		1.37	**3.81**	3.22	3.18
WL-201	5	**1.19**	0.4	0.17	< MDA		1.30	**1.06**	0.31	0.15	**1.06**	0.22	0.34	**1.21**	0.25	0.26	**0.95**	0.33	0.34	**2.38**	1.67	1.67
	15	**0.31**	0.18	0.12	< MDA		2.35	**0.63**	0.23	0.11	**0.47**	0.16	0.24	**0.53**	0.19	0.28	< MDA		0.47	< MDA		26.9
WL-202	5	**0.88**	0.37	0.12	**1.27**	0.77	1.02	**0.83**	0.29	0.11	**0.75**	0.41	0.54	**0.75**	0.57	0.49	NE	NE	NE	< MDA		46.8
	5 DUP (L)	**0.60**	0.28	0.14	< MDA		1.02	**0.53**	0.20	0.09	**0.94**	0.18	0.35	**0.87**	0.21	0.30	**1.02**	0.33	0.35	< MDA		1.21
	15	**0.24**	0.16	0.10	< MDA		3.75	**0.26**	0.14	0.08	< MDA		0.81	< MDA		0.70	< MDA		0.81	< MDA		42.6
WL-203	0	**1.95**	0.63	0.20	**1.46**	1.06	1.43	**3.03**	0.88	0.15	**1.07**	0.24	0.38	**1.09**	0.28	0.28	< MDA		0.72	< MDA		1.95
	5	**0.95**	0.38	0.11	< MDA		1.48	**0.8**	0.27	0.1	**0.94**	0.22	0.33	**0.85**	0.28	0.3	< MDA		0.59	**2.08**	1.31	1.99
	15	**0.60**	0.27	0.12	< MDA		1.86	**0.41**	0.18	0.11	**0.53**	0.21	0.33	< MDA		0.47	**0.43**	0.25	0.33	< MDA		2.12
WL-204	5	**0.77**	0.33	0.08	< MDA		1.03	**0.77**	0.26	0.09	**1.06**	0.22	0.31	**1.03**	0.25	0.24	< MDA		0.66	< MDA		1.62
	25	**0.36**	0.2	0.09	< MDA		1.04	**0.43**	0.19	0.08	**0.77**	0.20	0.36	**0.86**	0.20	0.28	**0.88**	0.38	0.36	< MDA		1.21
WL-205	5	**1.76**	0.5	0.09	**1.48**	0.81	0.92	**0.80**	0.28	0.11	**0.95**	0.22	0.26	**1.06**	0.23	0.26	< MDA		0.62	< MDA		1.34
	15	**0.95**	0.34	0.10	**1.76**	1.18	1.52	**1.01**		0.25	**0.90**	0.26	0.34	**0.94**	0.32	0.30	< MDA		0.65	< MDA		2.22
WL206	0	**4.17**	1.04	0.26	< MDA		2.53	**429**	135	0.7	**17.2**	1.2	0.4	**18.0**	1.2	0.4	**17.4**	1.5	0.4	**49.6**	7.1	3.1
	5	**1.17**	0.27	0.06	< MDA		4.01	**7.51**	1.54	0.23	**1.20**	0.37	0.57	**1.36**	0.45	0.57	**0.88**	0.65	0.57	< MDA		50.7
	10	**0.6**	0.17	0.04	**1.83**	0.79	1.04	**1.66**	0.51	0.21	**0.72**	0.18	0.28	**0.61**	0.21	0.22	**0.82**	0.30	0.28	< MDA		1.28

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.

* = Nuclear Regulatory Commission's Branch Technical Position (BTP) criteria for thorium-230 and radium-226, which are established at levels of background plus 5 pCi/g for surface samples and background plus 15 pCi/g for subsurface samples (15 cm depth), have been selected as reference values for comparison of all soil ananlytical data. Although this criteria is appropriate specifically for these two radionuclides, they are conservative values for comparison of all data. If no background concentration is established for a specific radionuclide, then a reference value of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples have been conservatively selected for comparison of the data.

-- = Not reported

DUP (F) = Field duplicate

DUP (L) = Laboratory duplicate

MDA = Minimum Detectable Activity

NE = Not Established

NA = Not available.

Bolded numbers indicate result reported above the minimum detectable activity (MDA).

Table B - 8 : Ford Property Soil Analytical Results - U-235 Decay Series

Boring	Depth (feet)	Uranium-235/236			Protactinium-231			Actinium-227			Radium-223		
		Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)		**1.15**			**NE**			**NE**			**NE**		
Reference Level Concentration *													
Surface Samples		**6.15**			**5**			**5**			**5**		
Subsurface Samples		**16.15**			**15**			**15**			**15**		
FP1 0-3	0.25	**0.15**	0.08	0.07	<6.1		6.1	<2.81		2.81	<13.2		13.2
FP1 0-3	0.25	**0.15**	0.07	0.05	<8.11		8.11	<2.12		2.12	<4.5		4.5
FP1 12-24	2	**0.13**	0.07	0.05	<6.26		6.26	<1.38		1.38	<2.98		2.98
FP2 0-3	0.25	**0.14**	0.08	0.1	<8.77		8.77	<1.69		1.69	<4.05		4.05
FP2 12-24	2	**0.26**	0.11	0.08	<8.86		8.86	<1.96		1.96	<4.76		4.76
FP3 0-3	0.25	**0.063**	0.051	0.057	<8.34		8.34	<2.23		2.23	<4.81		4.81
FP3 12-24	2	**0.38**	0.13	0.05	<4.24		4.24	<0.95		0.95	<2.42		2.42
FP4 0-3	0.25	**0.11**	0.07	0.06	<6.8		6.8	<1.48		1.48	<3.88		3.88
FP4 12-24	2	**0.095**	0.064	0.061	<8.97		8.97	<2.21		2.21	<4.84		4.84
FP5 0-3	0.25	**0.062**	0.047	0.05	<5.21		5.21	<1.39		1.39	<7.38		7.38
FP5 12-24	2	**0.22**	0.13	0.09	<7.37		7.37	<1.95		1.95	<4.66		4.66
FP6 0-3	0.25	**0.07**	0.06	0.1	<6.66		6.66	<1.52		1.52	<3.42		3.42
FP6 12-24	2	**0.093**	0.061	0.025	<5.87		5.87	<1.36		1.36	<3.25		3.25
FP7 0-3	0.25	**0.15**	0.1	0.04	<7.08		7.08	<1.42		1.42	<3.22		3.22
FP7 12-24	2	**0.05**	0.08	0.14	<6.77		6.77	<1.71		1.71	<3.98		3.98
FP8 0-3	0.25	**0.11**	0.09	0.08	<6.96		6.96	<1.33		1.33	<3.96		3.96
FP8 1-2	2	**0.07**	0.18	0.32	<8.08		8.08	<1.37		1.37	<0.49		0.49
WL-201	5	< MDA	0.17	0.22	< MDA		4.1	< MDA		0.82	< MDA		14.43
	15	< MDA	0.079	0.13	< MDA		4.09	< MDA		0.83	< MDA		12.87
WL-202	5	< MDA	0.076	0.17	< MDA		8.28	< MDA		1.64	< MDA		22.41
	5 DUP (L)	**0.16**	0.16	0.16	< MDA		3.47	< MDA		0.59	< MDA		12.26
	15	< MDA	0.003	0.12	< MDA		7.54	< MDA		1.4	< MDA		21.01
WL-203	0	**0.31**	0.25	0.27	< MDA		4.76	< MDA		0.85	< MDA		18.79
	5	**0.18**	0.17	0.15	< MDA		3.9	< MDA		1.14	< MDA		14.22
	15	< MDA	0.11	0.16	< MDA		4.99	< MDA		0.85	< MDA		13.76
WL-204	5	**0.22**	0.18	0.15	< MDA		3.81	< MDA		0.73	< MDA		11.67
	25	< MDA	0.06	0.11	< MDA		3.51	< MDA		0.69	< MDA		11.34
WL-205	5	**0.15**	0.14	0.15	< MDA		3.96	< MDA		0.67	< MDA		10.14
	15	**0.18**	0.15	0.14	< MDA		5.06	< MDA		0.93	< MDA		13.34
WL-206	0	< MDA	0.22	0.33	**7.93**	3.58	0.72	**6.15**	1.17	1.11	**6.73**		4.03
	0 DUP (L)	--		--	--		--	--		--	**8.75**		6.60
	5	**0.19**	0.1	0.06	< MDA		8.27	< MDA		1.75	< MDA		11.18
	10	< MDA	0.05	0.064	< MDA		3.2	< MDA		0.67	< MDA		5.49

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.

* = Nuclear Regulatory Commission's Branch Technical Position (BTP) criteria for thorium-230 and radium-226, which are established at levels of background plus 5 pCi/g for surface samples and background plus 15 pCi/g for subsurface samples (15 cm depth), have been selected as reference values for comparison of all soil ananlytical data. Although this criteria is appropriate specifically for these two radionuclides, they are conservative values for comparison of all data. If no background concentration is established for a specific radionuclide, then a reference value of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples have been conservatively selected for comparison of the data.

-- = Not reported

DUP (F) = Field duplicate

DUP (L) = Laboratory duplicate

MDA = Minimum Detectable Activity

NE = Not Established

NA = Not available.

Bolded numbers indicate result reported above the minimum detectable activity (MDA).

Table B -9 : Ford Property Soil Analytical Results - Thorium-232 Decay Series

Boring	Depth (feet)	Thorium-232			Radium-228			Thorium-228			Lead-212			Bismuth-212			Thallium-208		
		Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)		**1.55**			**2.37**			**1.33**			**2.26**			**NE**			**0.71**		
Reference Level Concentration																			
Surface Samples		**6.55**			**7.37**			**6.33**			**7.26**			**5**			**5.71**		
Subsurface Samples		**16.55**			**17.37**			**16.33**			**17.26**			**15**			**15.71**		
FP1 0-3	0.25	**1.1**	0.38	0.22	<2.13		2.13	**1.15**	0.39	0.21	<0.97		0.97	<5.69		5.69	<0.51		0.51
FP1 0-3	0.25	**1.06**	0.27	0.05	<2.06		2.06	**1.22**	0.3	0.08	**0.92**	0.42	0.47	<5.36		5.36	<0.53		0.53
FP1 12-24	2	**0.84**	0.23	0.05	<2.29		2.29	**0.93**	0.25	0.09	**0.8**	0.38	0.36	<5.82		5.82	<0.5		0.5
FP2 0-3	0.25	**1.08**	0.29	0.14	<2.85		2.85	**1.2**	0.31	0.09	**1.24**	0.53	0.44	<6.71		6.71	<0.62		0.62
FP2 12-24	2	**1.13**	0.29	0.1	<2.61		2.61	**1.17**	0.3	0.18	**1.41**	0.5	0.51	<6.62		6.62	<0.59		0.59
FP3 0-3	0.25	**0.85**	0.23	0.1	<2.05		2.05	**0.9**	0.24	0.08	**1.13**	0.43	0.45	<4.13		4.13	<0.51		0.51
FP3 12-24	2	**0.91**	0.24	0.05	<1.66		1.66	**0.78**	0.22	0.11	**0.88**	0.28	0.29	<4.24		4.24	**0.44**	0.19	0.17
FP4 0-3	0.25	**1.16**	0.3	0.06	<2.60		2.6	**1.53**	0.37	0.12	**1.15**	0.68	0.38	<4.36		4.36	<0.61		0.61
FP4 12-24	2	**1.28**	0.32	0.05	<1.73		1.73	**1.42**	0.35	0.16	**1.23**	0.6	0.55	<7.11		7.11	<0.58		0.58
FP5 0-3	0.25	**1.38**	0.34	0.08	<0.94		0.94	**1.46**	0.36	0.12	**1.14**	0.35	0.28	<2.96		2.96	**0.46**	0.2	0.18
FP5 12-24	2	**1.2**	0.3	0.02	<1.96		1.96	**1.25**	0.31	0.12	**0.93**	0.36	0.56	<6.68		6.68	<0.48		0.48
FP6 0-3	0.25	**0.95**	0.24	0.06	<1.56		1.56	**0.97**	0.25	0.1	**1.26**	0.37	0.37	<6.74		6.74	<0.48		0.48
FP6 12-24	2	**1.2**	0.28	0.05	<1.95		1.95	**0.91**	0.23	0.05	<0.76		0.76	<6.09		6.09	<0.49		0.49
FP7 0-3	0.25	**1.14**	0.27	0.05	<1.78		1.78	**1.08**	0.26	0.09	**1.59**	0.38	0.32	<5.54		5.54	<0.39		0.39
FP7 12-24	2	**0.1**	0.23	0.03	<2.13		2.13	**1.18**	0.27	0.07	<0.72		0.72	<6.19		6.19	<0.52		0.52
FP8 0-3	0.25	**1.57**	0.35	0.09	<1.68		1.68	**1.37**	0.31	0.09	**0.98**	0.4	0.46	<5.67		5.67	<0.57		0.57
FP8 1-2	2	**1.29**	0.29	0.067	<2.92		2.92	**1.37**	0.3	0.1	**1.86**	0.51	0.41	<7.84		7.84	<0.56		0.56
WL-201	5	**0.32**	0.15	0.13	< MDA		1.13	**0.24**	0.14	0.15	**1.04**	0.2	0.21	< MDA		1.62	**0.31**	0.14	0.19
	15	**0.28**	0.15	0.08	< MDA		0.73	**0.43**	0.19	0.15	**0.49**	0.2	0.19	< MDA		1.31	**0.21**	0.11	0.16
WL-202	5	**0.44**	0.20	0.09	< MDA		1.59	**0.75**	0.28	0.16	**0.97**	0.16	0.16	< MDA		2.86	**0.42**	0.25	0.26
	5 DUP (L)	**0.39**	0.17	0.08	< MDA		1.14	**0.17**	0.11	0.14	**0.97**	NA	0.16	< MDA		1.47	< MDA	0.14	0.14
	15	**0.16**	0.11	0.08	< MDA		1.18	**0.31**	0.16	0.14	**0.96**	0.39	0.33	< MDA		2.77	< MDA	NA	0.39
WL-203	0	**0.43**	0.24	0.12	< MDA		1.28	**0.75**	0.34	0.21	**1.17**	0.23	0.26	< MDA		2.02	**0.58**	0.19	0.21
	5	**0.14**	0.1	0.06	< MDA		0.99	**0.32**	0.16	0.18	**1.04**	0.25	0.20	< MDA		1.68	**0.20**	0.13	0.17
	15	**0.23**	0.13	0.08	< MDA		0.98	**0.28**	0.15	0.13	**0.52**	0.3	0.20	< MDA		1.62	< MDA		0.20
WL-204	5	**0.47**	0.2	0.06	**0.99**	0.45	0.56	**0.55**	0.22	0.14	**0.85**	0.27	0.24	< MDA		1.39	**0.28**	0.16	0.16
	25	**0.32**	0.16	0.07	**0.85**	0.36	0.72	**0.21**	0.14	0.18	**0.75**	0.17	0.18	< MDA		1.13	**0.22**	0.13	0.15
WL-205	5	**0.66**	0.25	0.08	< MDA		1.19	**0.47**	0.2	0.13	**0.90**	0.21	0.22	< MDA		1.56	**0.30**	0.14	0.16
	15	**0.95**	0.38	0.15	< MDA		0.95	**0.70**	0.33	0.29	**0.89**	0.22	0.19	< MDA		1.80	< MDA		0.18
WL206	0	**11.2**	4.4	0.6	< MDA		1.21	**1.01**	0.89	0.63	**1.09**	0.3	0.30	< MDA		2.44	**0.34**	0.23	0.25
	5	**1.12**	0.4	0.15	< MDA		1.58	**0.91**	0.37	0.28	**0.76**	0.40	0.41	< MDA		2.92	< MDA		0.42
	10	**0.82**	0.33	0.16	< MDA		0.96	**1.06**	0.4	0.28	**1.00**	0.18	0.16	**1.02**	0.85	0.97	**0.40**	0.17	0.15

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.

* = Nuclear Regulatory Commission's Branch Technical Position (BTP) criteria for thorium-230 and radium-226, which are established at levels of background plus 5 pCi/g for surface samples and background plus 15 pCi/g for subsurface samples (15 cm depth), have been selected as reference values for comparison of all soil ananlytical data. Although this criteria is appropriate specifically for these two radionuclides, they are conservative values for comparison of all data. If no background concentration is established for a specific radionuclide, then a reference value of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples have been conservatively selected for comparison of the data.

-- = Not reported

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NA = Not available.

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Table B - 10 : Split Soil Analytical Results - U-238 Decay Series

Boring	Depth (feet)	Uranium-238						Thorium-234						Uranium-234						Thorium-230					
		Quanterra			Accu-Labs			Quanterra						Quanterra			Accu-Labs			Quanterra			Accu-Labs		
		Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background (Mean +2 Std Dev)		2.24						2.76						2.73						3.96					
Reference Level Concentration*																									
Surface Samples		7.24						7.76						7.73						8.96					
Subsurface Samples		17.24						17.76						17.73						18.96					
AREA 1																									
WL-106	0	**105**	22	*2*	**87**	7.2	*0.9*	*MDA*	--	*18.75*	**180**	49	*11*	**105**	22	*3*	**110**	8.0	*0.9*	**9700**	1600	*11.8*	**57000**	4100	*480*
WL-112	5	**3.44**	1.58	*0.42*	**1.2**	0.3	*0.1*	*MDA*	--	*2.55*	*MDA*	--	*0.91*	**2.92**	1.46	*0.89*	**0.9**	0.2	*0.1*	**84.4**	15.8	*1.9*	**1500**	240	*23*
WL-117	10	**2.90**	0.86	*0.16*	**1.3**	0.3	*0.1*	**1.44**	0.59	*0.39*	*MDA*	--	*0.54*	**1.72**	0.61	*0.25*	**1.4**	0.4	*0.1*	**36.58**	7.4	*0.13*	**1400**	230	*33*
AREA 2																									
WL-213	0	**1.53**	0.55	*0.42*	**0.9**	0.3	*0.1*	**2.05**	1.31	*1.51*	*MDA*	--	*0.65*	**1.64**	0.58	*0.45*	**0.9**	0.3	*0.1*	**24.2**	4.7	*0.2*	**30**	3.3	*0.6*
WL-214	5	**0.81**	0.3	*0.09*	**0.6**	0.2	*0.1*	**1.14**	0.74	*1.08*	**0.43**	0.32	*0.35*	**1.09**	0.36	*0.12*	**0.8**	0.2	*0.1*	**44.4**	7.8	*0.21*	**2.9**	1.1	*0.5*
WL-217	5	**0.51**	0.21	*0.08*	**0.3**	0.1	*0.1*	*MDA*	--	*1.80*	**0.20**	0.11	*0.20*	**0.45**	0.2	*0.08*	**0.5**	0.2	*0.1*	**0.96**	0.3	*0.13*	**1.1**	0.3	*0.1*
WL-226	20	**6.32**	2.24	*0.91*	**2.8**	0.4	*0.1*	**2.55**	1.82	*2.31*	**0.80**	0.41	*0.54*	**6.02**	2.2	*1.31*	**2.9**	0.4	*0.2*	**173**	31	*1.0*	**530**	140	*29*
WL-234	10	**138**	42	*5.0*	**100**	56	*0.4*	**24.5**	15.8	*19.9*	**140**	25	*21*	**128**	39	*3*	**83**	52	*0.8*	**57300**	19300	*238*	**83000**	530	*28*
WL-243	0	**3.63**	0.91	*0.18*	**3.1**	0.7	*0.1*	*MDA*	--	*1.94*	**2.5**	1.4	*2.2*	**3.99**	0.98	*0.24*	**3.3**	0.7	*0.1*	**265**	50	*0.22*	**1200**	230	*50*
WL-244	0	**1.35**	0.4	*0.09*	**1.2**	0.3	*0.1*	*MDA*	--	*1.24*	*MDA*	--	*0.49*	**0.88**	0.3	*0.12*	**1.2**	0.3	*0.1*	**20.8**	4.1	*0.71*	**63**	4.8	*0.5*

Boring	Depth (feet)	Radium-226						Lead-214						Bismuth-214						Lead-210					
		Quanterra			Accu-Labs			Quanterra			Accu-Labs			Quanterra			Accu-Labs			Quanterra			Accu-Labs		
		Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background (Mean +2 Std Dev)		1.30						1.13						1.61						3.77					
Reference Level Concentration*																									
Surface Samples		6.3						6.13						6.61						8.77					
Subsurface Samples		16.3						16.13						16.61						18.77					
AREA 1																									
WL-106	0	**906**	37	*2*	**910**	93	*23*	**650**	52	*13*	**1100**	99	*3.3*	**908**	38	*2*	**1000**	57	*2.9*	**1040**	135	*25*	**860**	150	*22*
WL-112	5	**4.66**	0.46	*0.42*	**6.3**	1.2	*1.7*	**5.14**	0.36	*0.34*	**7.0**	0.8	*0.23*	**4.35**	0.68	*0.42*	**6.5**	0.6	*0.25*	**11.2**	2.80	*2.90*	**17**	4.0	*2.4*
WL-117	10	**3.15**	0.19	*0.07*	**4.0**	0.93	*1.4*	**2.92**	0.23	*0.08*	**3.9**	0.40	*0.23*	**3.22**	0.23	*0.07*	**3.2**	0.4	*0.23*	**5.82**	1.11	*0.57*	**5.1**	1.0	*1.1*
AREA 2																									
WL-213	0	**1.00**	0.26	*0.37*	**1.1**	0.70	*1.3*	**1.28**	0.28	*0.25*	**1.3**	0.21	*0.17*	*MDA*	--	*0.70*	**1.2**	0.3	*0.17*	**2.36**	1.4	*2.13*	**2.3**	1.0	*1.6*
WL-214	5	**0.95**	0.18	*0.22*	**1.3**	0.45	*0.72*	**1.01**	0.19	*0.23*	**1.1**	0.12	*0.09*	*MDA*	--	*0.62*	**1.0**	0.1	*0.11*	*MDA*	--	*1.23*	**1.0**	0.5	*0.93*
WL-217	5	**0.60**	0.21	*0.31*	**0.64**	0.31	*0.62*	**0.53**	0.23	*0.25*	**0.50**	0.08	*0.11*	*MDA*	--	*0.52*	**0.68**	0.09	*0.10*	**1.71**	1.54	*1.36*	*MDA*	--	*0.40*
WL-226	20	**3.26**	0.44	*0.40*	**5.1**	1.1	*1.5*	**3.26**	0.47	*0.42*	**3.4**	0.4	*0.23*	*MDA*	--	*1.21*	**3.4**	0.4	*0.23*	**5.93**	2.32	*2.62*	**2.4**	0.85	*1.1*
WL-234	10	**3060**	116	*4*	**1800**	180	*36*	**1100**	95	*25*	**2200**	170	*4.9*	**3060**	108	*4*	**2100**	100	*4.3*	**1300**	157	*24*	**500**	75	*16*
WL-243	0	**4.78**	0.44	*0.33*	**9.2**	1.7	*2.2*	**5.26**	0.49	*0.28*	**8.8**	1.0	*0.31*	**4.2**	0.67	*0.33*	**7.3**	0.7	*0.30*	**9.58**	2.32	*2.07*	**18**	6.8	*3.2*
WL-244	0	**1.54**	0.22	*0.33*	**2.6**	0.79	*1.4*	**1.58**	0.26	*0.21*	**1.7**	0.24	*0.22*	**1.31**	0.35	*0.33*	**1.4**	0.2	*0.21*	**2.02**	1.29	*1.48*	**1.4**	0.70	*0.97*

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted
* = Nuclear Regulatory Commissions's Branch Technical Position (BTP) criteria for thorium-230 and radium-226, which are established at levels of background plus 5 pCi/g for surface samples and background plus 15 pCi/g for subsurface samples (15 cm depth), have been selected as reference values for comparison of all soil analytical data. Although this criteria is appropiate specifically for these two radionuclides they are conservative values for comparison of all data. If no background concentration is established for a specific radionuclide, then a reference value of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples have been conservatively selected for comparison of the data.
-- = Not reported
MDA = Minimum detectable activity
Bolded numbers indicate result reported above the minimum detectable activity.

Table B -11 : Split Soil Analytical Results - U-235 Decay Series

Boring	Depth (feet)	Uranium-235/236 Quanterra Result	Quanterra +/- Sigma	Quanterra MDA	Accu-Labs Result	Accu-Labs +/- Sigma	Accu-Labs MDA	Uranium-235 Quanterra Result	Quanterra +/- Sigma	Quanterra MDA	Accu-Labs Result	Accu-Labs +/- Sigma	Accu-Labs MDA
Site Specific Background(Mean+2 Std Dev)		1.15						NE					
Reference Level Concentration *													
Surface Samples		6.15						5					
Subsurface Samples		16.15						15					
Area 1													
WL-106	0	**6.86**	1.99	3.10	**5.7**	1.9	0.4	**75.5**	8.5	[illegible]	**56**	15	1.4
WL-112	5	MDA	–	1.1	**0.1**	0.10	0.1	MDA	–	0.99	**0.39**	0.13	0.10
WL-117	10	MDA	–	0.23	MDA	--	0.1	**0.30**	0.06	0.27	**0.25**	0.08	0.09
Area 2													
WL-213	0	**0.45**	0.31	0.38	**0.1**	0.1	0.1	MDA	–	0.86	MDA	–	0.05
WL-214	5	**0.81**	0.33	0.14	**0.1**	0.1	0.1	MDA	–	0.52	**0.08**	0.03	0.04
WL-217	5	MDA	--	0.10	MDA	–	0.1	MDA	--	0.53	**0.04**	0.02	0.04
WL-226	20	MDA	--	1.19	MDA	--	0.1	MDA	–	0.87	**0.32**	0.10	0.09
WL-234	10	**10.9**	7.5	13	**24**	27	0.4	**774**	150	12	**110**	30	2.2
WL-243	0	**0.58**	0.31	0.22	**0.1**	0.1	0.1	MDA	–	0.75	**0.57**	0.18	0.11
WL-244	0	MDA	–	0.14	MDA	–	0.1	MDA	--	0.53	**0.16**	0.06	0.09

Boring	Depth (feet)	Protactinium-231 Quanterra Result	Quanterra +/- Sigma	Quanterra MDA	Accu-Labs Result	Accu-Labs +/- Sigma	Accu-Labs MDA	Actinium-227 Quanterra Result	Quanterra +/- Sigma	Quanterra MDA	Accu-Labs † Result	Accu-Labs +/- Sigma	Accu-Labs MDA	Radium-223 Quanterra Result	Quanterra +/- Sigma	Quanterra MDA	Accu-Labs Result	Accu-Labs +/- Sigma	Accu-Labs MDA
Site Specific Background(Mean+2 Std Dev)		NE						NE						NE					
Reference Level Concentration *																			
Surface Samples		5						5						5					
Subsurface Samples		15						15						15					
Area 1																			
WL-106	0	**544**	61	41	**610**	110	47	**305**	33	8	--	–	–	**939**		55	**130**	24	[illegible]
WL-112	5	MDA	--	6.54	**4.8**	2.2	3.2	MDA	--	1.59	–	–	–	MDA	--	16.7	**1.2**	0.37	0.22
WL-117	10	MDA	--	1.45	MDA	–	3.2	**0.79**	0.24	0.23	--	–	–	**5.48**		1.32	**0.28**	0.08	0.12
Area 2																			
WL-213	0	MDA	–	5.11	MDA	--	4.4	MDA	–	1.03	--	–	–	MDA	–	18.1	MDA	–	0.19
WL-214	5	MDA	--	3.32	MDA	--	2.0	MDA	–	0.55	–	–	--	MDA	–	2.51	**0.07**	0.03	0.06
WL-217	5	MDA	--	3.30	MDA	--	2.3	MDA	--	0.82	-	–	--	MDA	–	19.93	MDA	–	0.07
WL-226	20	MDA	–	7.31	**4.3**	1.7	3.0	MDA	--	1.47	--	–	--	MDA	–	25.9	**0.56**	0.11	0.12
WL-234	10	**1050**	160	64	**520**	230	50	**952**	108	12	--	–	--	**5270**		232	**88**	14	[illegible]
WL-243	0	**5.22**	2.32	4.03	**6.5**	2.5	4.4	**3.58**	0.88	0.82	–	–	--	MDA	–	25.1	**3.9**	0.50	0.52
WL-244	0	MDA	–	4.37	MDA	–	6.2	**0.81**	0.45	0.73	--	–	--	MDA	–	26.6	**0.16**	0.08	0.11

All values expressed as picoCuries per gram (pCi/g) unless otherwise noted.

* = Nuclear Regulatory Commission's Branch Technical Position (BTP) criteria for thorium-230 and radium-226, which are established at levels of background plus 5 pCi/g for surface samples and background plus 15 pCi/g for subsurface samples (15 cm depth), have been selected as reference values for comparison of all soil analytical data. Although this criteria is appropriate specifically for these two radionuclides, they are conservative values for comparison of all data. If no background concentration is established for a specific radionuclide then a reference value of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples have been conservatively selected for comparison of the data.

† = Accu-Labs actinium-227's energy and photon yield were too low to be seen on Accu-Labs gamma detectors

-- = Not reported.

MDA = Minimum Detectable Activity

NE = Not established

Bolded numbers indicate result reported above the minimum detectable activity

Table B - 12 : Split Soil Analytical Results - Thorium-232 Decay Series

Boring	Depth (feet)	Thorium-232						Radium-228						Thorium-228					
		Quanterra			Accu-labs			Quanterra			Accu-labs [1]			Quanterra			Accu-labs		
		Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)		1.55						2.37						1.33					
Reference Level Concentration*																			
Surface Samples		6.55						7.37						6.33					
Subsurface Samples		16.55						17.37						16.33					
AREA 1																			
WL-106	0	**35.2**		11.2	**40**	150	170	< MDA	--	5.84	--	--	--	< MDA	--	7.89	< MDA	--	240
WL-112	5	< MDA	--	1.56	< MDA	--	51	< MDA	--	1.20	--	--	--	**1.55**	1.48	1.48	< MDA	--	39
WL-117	10	**1**	0.35	0.12	< MDA	--	23	**0.64**	0.14	0.16	--	--	--	**0.47**	0.22	0.18	< MDA	--	23
AREA 2																			
WL-213	0	**1.11**	0.41	0.20	< MDA	--	0.2	< MDA	--	0.90	--	--	--	**0.79**	0.34	0.22	< MDA	--	0.2
WL-214	5	**0.41**	0.2	0.14	**0.5**	0.4	0.2	< MDA	--	0.81	--	--	--	**0.5**	0.23	0.2	**0.5**	0.4	0.2
WL-217	5	< MDA	--	0.085	**0.1**	0.1	0.1	< MDA	--	0.81	--	--	--	< MDA	--	0.15	**0.1**	0.1	0.1
WL-226	20	< MDA	--	0.85	< MDA	--	21	< MDA	--	1.12	--	--	--	< MDA	--	0.99	< MDA	--	21
WL-234	10	< MDA	--	240	**140**	25	20	**14.5**	7.9	10.3	--	--	--	< MDA	--	196	< MDA	--	20
WL-243	0	**6.73**	1.36	0.15	< MDA	--	25	**1.13**	0.54	0.84	--	--	--	**1.11**	0.35	0.15	< MDA	--	35
WL-244	0	**0.78**	0.68	0.65	**0.3**	0.3	0.2	< MDA	--	1.05	--	--	--	< MDA	--	1.23	< MDA	--	0.2

Boring	Depth (feet)	Radium-224						Lead-212					
		Quanterra			Accu-labs [2]			Quanterra			Accu-labs		
		Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
Site Specific Background(Mean+2 Std Dev)		NE						2.26					
Reference Level Concentration*													
Surface Samples		5						7.26					
Subsurface Samples		15						17.26					
AREA 1													
WL-106	0	**1760**	219	24	--	--	--	< MDA	--	2.90	< MDA	--	5.2
WL-112	5	< MDA	--	6.16	--	--	--	**1.08**	0.34	0.28	**0.72**	0.38	0.17
WL-117	10	**6.48**	1.12	0.71	--	--	--	**0.58**	0.09	0.05	**0.57**	0.22	0.14
AREA 2													
WL-213	0	< MDA	--	4.09	--	--	--	< MDA	--	0.37	**0.38**	0.11	0.12
WL-214	5	< MDA	--	2.31	--	--	--	**0.62**	0.16	0.21	**0.56**	0.13	0.07
WL-217	5	< MDA	--	2.83	--	--	--	< MDA	--	0.23	**0.16**	0.04	0.05
WL-226	20	< MDA	--	5.32	--	--	--	< MDA	--	0.39	**0.99**	0.26	0.33
WL-234	10	< MDA	--	87.5	--	--	--	**10.8**	2.7	3.2	**82**	35	8.5
WL-243	0	< MDA	--	4.33	--	--	--	**1.04**	0.25	0.22	**0.79**	0.50	0.21
WL-244	0	< MDA	--	2.24	--	--	--	**0.86**	0.21	0.2	**0.84**	0.17	0.12

Boring	Depth (feet)	Bismuth-212						Thallium 208			
		Quanterra			Accu-labs			Quanterra		Accu-labs	
		Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	MDA	Result	MDA
Site Specific Background(Mean+2 Std Dev)		NE						0.71			
Reference Level Concentration*											
Surface Samples		5						5.71			
Subsurface Samples		15						15.71			
AREA 1											
WL-106	0	< MDA	--	10.2	< MDA	--	32	< MDA	1.32	**6.8**	2.6
WL-112	5	< MDA	--	2.02	**1.8**	0.99	1.7	**0.43**	0.21	**0.42**	0.12
WL-117	10	< MDA	--	0.40	< MDA	--	3.0	**0.16**	0.04	**0.27**	0.12
AREA 2											
WL-213	0	< MDA	--	1.54	< MDA	--	2.6	< MDA	0.22	**0.22**	0.09
WL-214	5	< MDA	--	1.34	**0.74**	0.36	0.74	**0.24**	0.17	**0.22**	0.05
WL-217	5	< MDA	--	1.26	< MDA	--	1.2	< MDA	0.19	**0.08**	0.05
WL-226	20	< MDA	--	2.05	< MDA	--	2.6	< MDA	0.25	**0.14**	0.11
WL-234	10	< MDA	--	18.6	< MDA	--	49	**3.09**	2.26	**7.9**	3.8
WL-243	0	< MDA	--	1.80	< MDA	--	4.1	**0.46**	0.15	**0.28**	0.16
WL-244	0	< MDA	--	1.43	< MDA	--	1.5	**0.23**	0.17	**0.42**	0.11

All values expressed as picoCuries per gram (pCi/g), unless otherwise noted.

* = Nuclear Regulatory Commission's Branch Technical Position (BTP) criteria for thorium-230 and radium-226, which are established at levels of background plus 5 pCi/g for surface samples and background plus 15 pCi/g for subsurface samples (15 cm depth), have been selected as reference values for comparison of all soil analytical data. Although this criteria is appropriate specifically for these two radionuclides they are conservative values for comparison of all data. If no background concentration is established for a specific radionuclide, then a reerence value of 5 pCi/g for surface samples and 15 pCi/g for subsurface samples have been conservatively selected for comparison of the data.

1 = Radium-228 is not a gamma emitter so it does not show up on gamma spectrometry. However, radium-228 decays to actinium-228, which has three strong gamma peaks. The peak at 911 KeV is traditionally reported as the radium-228 concentration because of the equilibrium that exists between radium-228 and actinium-228.

2 = Radium-224 has its highest gamma emitter at 240 KeV, and has a photon yield of less than 4%. There are two strong peaks that usually interfere with the radium-224 peak: lead-212 at 241 KeV and lead-212 at 238 KeV. Both of these peaks have higher photon yields which prevents the visibility of radium-224.

-- = Not reported

MDA = Minimum detectable activity

NE = Not established

Bolded numbers indicate result reported above the minimum detectable activity.

Table B - 13 : Soil Analytical Results - Priority Pollutant Metals

Boring	Depth	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Zinc
	(feet)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)
AREA 1											
WL-106	0	**7.9**	**0.44**	< 0.50	**7.9**	**55**	**86**	< 0.10	**73**	**1.8**	**35**
	30	**3.2**	**0.55 Z**	< 0.50	**9.5 Z**	**11 Z**	**8.7 Z**	< 0.10	**15 Z**	< 0.25	**43 Z**
	30 DUP (F)	**2.7**	**0.45 Z**	< 0.50	**8.6 Z**	**16 Z**	**7.9 Z**	< 0.10	**13 Z**	< 0.25	**32 Z**
WL-108	30	**3.0**	**0.32**	< 0.50	**7.8**	**10**	**6.6**	< 0.10	**13**	**0.36**	**33**
WL-111	0	**1.4 Z**	< 0.25	< 0.50	**4.9 Z**	**5.3 Z**	**4.8**	< 0.10	**10 Z**	< 0.25	**22 Z**
WL-112	0	**3.5 Z**	**0.40**	< 0.50	**8.8 Z**	**10 Z**	**9.0**	< 0.10	**13 Z**	< 0.25	**35 Z**
WL-113	45	**0.76**	< 0.25	< 0.50	**3.1**	**7.7**	**19**	< 0.10	**4.7**	< 0.25	**120**
WL-114	0	**220**	**3.3**	**7.9**	**31**	**2300**	**320**	**0.17**	**3600**	**250**	**120**
WL-115	5	**4.5**	**0.25**	**4.2 Z**	**280**	**70**	**900**	< 0.10	**19**	**1.3**	**560**
	38	**1.9**	< 0.25	< 0.50	**3.2**	**1.8**	**3.0**	< 0.10	**7.3**	< 0.25	**16**
WL-116	0	**3.8 Z**	**0.33**	< 0.50	**7.1 Z**	**10 Z**	**7.6**	< 0.10	**13 Z**	< 0.25	**31 Z**
WL-119	50	**1.9**	< 0.25	< 0.50	**4.1**	**2.3**	**3.3**	< 0.10	**7.5**	< 0.25	**18**
	50 DUP (F)	**1.7**	< 0.25	< 0.50	**4.0**	**1.9**	**2.8**	< 0.10	**6.7**	< 0.25	**16**
AREA 2											
WL-203	0	**2.2 Z**	**0.44**	< 0.50	**6.9 Z**	**12 Z**	**27**	< 0.10	**12 Z**	< 0.25	**41 Z**
WL-206	0	**2.9 Z**	**2.2**	**6.3**	**49 Z**	**160 Z**	**400**	< 0.10	**33 Z**	**0.58**	**400 Z**
WL-208	15	**2.8 Z**	**0.27**	< 0.50	**6.4**	**7.0**	**6.8**	< 0.10	**12**	< 0.25	**40 Z**
	20[1]	**1.2 Z**	< 0.25	**1.3 Z**	**890**	**46**	**2100**	< 0.10	**58**	< 0.25	**1100 Z**
	28	**3.0 Z**	**0.60**	< 0.50	**10**	**17**	**21**	< 0.10	**16**	< 0.25	**50 Z**
WL-209	0	**35**	**0.47**	**1.2**	**6.1**	**360**	**1900**	**0.27**	**680**	**1.0**	**27**
WL-210	0	**14**	**0.29**	**0.84**	**25**	**280**	**2200**	**0.24**	**660**	**38**	**40**
	15	**0.70 Z**	< 0.25	< 0.50	**11**	**2.2**	**7.5**	< 0.10	**1.3**	< 0.25	**7.3 Z**
WL-213	0	**2.3 Z**	< 1.2	< 2.5	**33 Z**	**38 Z**	**45**	< 0.10	**9.1 Z**	< 0.25	**210 Z**
	25	**2.2**	**0.29**	< 0.50	**8.4**	**6.4**	**5.5**	< 0.10	**10**	< 0.25	**56**
WL-214	25	**1.8**	**0.29**	< 0.50	**8.9**	**15**	**22**	< 0.10	**11**	< 0.25	**46**
WL-215	0	**2.0 Z**	< 1.2	**3.0**	**35 Z**	**85 Z**	**120**	< 0.10	**7.6 Z**	< 0.25	< 1.0
WL-218	0	**3.4 Z**	**0.37**	**0.54**	**8.9 Z**	**14 Z**	**72**	< 0.10	**12 Z**	< 0.25	**54 Z**
	25	**11**	**0.32**	**1.3**	**72**	**100**	**180**	< 0.10	**13**	< 0.25	**90**
WL-221	35	**1.5**	< 0.25	< 0.50	**14**	**17**	**39**	**0.18**	**8.0**	< 0.25	**91**
WL-222	0	**2.9 Z**	**0.40**	< 0.50	**9.8 Z**	**30 Z**	**36**	< 0.10	**17 Z**	**0.46**	**78 Z**
	30	**1.9**	< 0.25	< 0.50	**4.0**	**3.2**	**4.6**	< 0.10	**8.2**	< 0.25	**20**
	30 DUP (F)	**1.4**	< 0.25	< 0.50	**3.2**	**1.8**	**4.5**	< 0.10	**6.9**	< 0.25	**15**
WL-226	43	**0.78**	< 0.25	< 0.50	**3.0**	**1.4**	**5.7**	< 0.10	**5.8**	< 0.25	**12**
WL-227	40	**0.71**	< 0.25	< 0.50	**3.1**	**1.0**	**3.0**	< 0.10	**5.2**	< 0.25	**10**
WL-230	16	**2.2 Z**	< 0.25	< 0.50	**5.5**	**26 Z**	**33 Z**	< 0.10	**6.4**	< 0.25	**62 Z**
	35	< 0.50	< 0.25	< 0.50	**2.0**	**1.2 Z**	< 2.5	< 0.10	**4.0**	< 0.25	**8.8 Z**
WL-231	0	**1.6 Z**	< 1.2	**3.4**	**43 Z**	**31 Z**	**34**	< 0.10	**10 Z**	**0.61**	**180 Z**
WL-235	0	**3.4 Z**	**0.36**	**0.56**	**10 Z**	**57 Z**	**32**	< 0.10	**12 Z**	**0.25**	**46 Z**

[1] = Analytical data represents contents from a 5-gallon container brought up with the augers and severely damaged during drilling operation.
DUP (F) = Field duplicate
ppm = parts per million
< = Result reported below detection limit
Bolded numbers indicate result reported above appropriate detection limit.
Z = Estimated value. Analyte percent recoveries were outside control limits for the matrix spike/matrix spike duplicate (MS/MSD) sample.
Antimony was only detected in WL-115-5 (4.8 ppm) and WL-208-20 (7.2 Z ppm).
Thallium (USEPA Method SW846-7841) was only detected in WL-114 (1.2 ppm).
Total Cyanide (USEPA Method 9010) was only detected in WL-115-5 (1.1 ppm) and WL-208-20 (0.62 ppm).

Table B-14 : Soil Analytical Results - Total Petroleum Hydrocarbons

Boring	Depth (feet)	Gasoline Range Result (ppm)	Diesel Range Result (ppm)	Motor Oil Range Result (ppm)
AREA 1				
WL-101	5	*< 10*	**110**	*< 10*
	25	*< 10*	*< 10*	*< 10*
WL-103	15	*< 10*	*< 10*	*< 10*
	25	--	--	--
WL-104	25	*< 10*	*< 10*	*< 10*
	35	--	--	--
WL-106	0	*< 10*	*< 10*	**76**
	30	*< 10*	*< 10*	*< 10*
	30 DUP (F)	*< 10*	*< 10*	*< 10*
WL-108	30	*< 10*	*< 10*	*< 10*
WL-111	0	*< 10*	*< 10*	*< 10*
WL-112	0	*< 10*	*< 10*	*< 10*
WL-113	45	*< 10*	*< 10*	*< 10*
WL-114	0	*< 100*	*< 100*	**130**
WL-115	5	**120**	*< 20*	**100**
	38	*< 10*	*< 10*	*< 10*
WL-116	0	*< 10*	*< 10*	*< 10*
WL-119	50	*< 10*	*< 10*	*< 10*
	50 DUP (F)	*< 10*	*< 10*	*< 10*
AREA 2				
WL-203	0	*< 10*	*< 10*	*< 10*
WL-206	0	*< 10*	*< 10*	**29**
WL-208	15	**240**	**51**	**79**
	20[1]	**5000**	*< 4000*	**16000**
	28	**24**	*< 10*	*< 10*
WL-209	0	*< 10*	*< 10*	**11**
WL-210	0	*< 10*	**31**	*< 10*
	15	**2600**	**1200**	**3100**
WL-213	0	*< 10*	*< 10*	**25**
	25	*< 10*	*< 10*	**19**
WL-214	25	*< 50*	*< 50*	**190**
WL-215	0	*< 200*	*< 200*	**360**
WL-218	0	*< 200*	*< 200*	*< 200*
	25	**880**	**310**	**900**
WL-221	35	*< 10*	*< 10*	**35**
WL-222	0	*< 10*	*< 10*	**19**
	30	*< 10*	*< 10*	*< 10*
	30 DUP (F)	*< 10*	*< 10*	*< 10*
WL-226	43	*< 50*	*< 50*	**210**
WL-227	40	*< 50*	*< 50*	**120**
WL-230	16	*< 200*	*< 200*	**1900**
	35	*< 10*	*< 10*	*< 10*
WL-231	0	*< 10*	*< 10*	**68**
WL-235	0	*< 50*	*< 50*	**99**

[1] = Analytical data represents contents from a 5-gallon container brought up with the augers and severely damaged during drilling operations.
-- = Not reported
DUP (F) = Field duplicate
ppm = parts per million
< = Result reported below detection limit
Bolded numbers indicate result reported above appropriate detection limit.

Table B-15 : Soil Analytical results - Volatile Organic Compounds

Boring	Depth (feet)	Toluene Result (ppm)	Ethyl benzene Result (ppm)	m & p Xylene Result (ppm)	o-Xylene Result (ppm)	Chlorobenzene Result (ppm)	1,4-Dichlorobenzene Result (ppm)	2-Butanone Result (ppm)	Acetone Result (ppm)	Methylene Chloride Result (ppm)
AREA 1										
WL-101	5	< 0.005	< 0.005	**0.002 J**	< 0.005	**0.002 J**	**0.012**	--	--	< 0.005
	25	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	--	--	< 0.005
WL-103	15	< 0.005	< 0.005	< 0.005	< 0.005	**0.078**	**0.002 J**	< 0.025	< 0.025	< 0.005
	25	< 0.50	< 0.50	< 0.50	< 0.50	**0.53**	< 0.50	--	--	< 0.50
WL-104	25	< 0.025	< 0.025	< 0.025	< 0.025	**0.94**	**0.015 J**	< 0.120	< 0.120	< 0.025
	35	< 0.50	< 0.50	< 0.50	< 0.50	**0.22 J**	< 0.50	--	--	< 0.50
WL-106	0	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.005
	30	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	**0.013 J**	**0.064**	< 0.005
	30 DUP (F)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	**0.020 J**	**0.09**	< 0.005
WL-108	30	**0.008**	**0.005**	< 0.005	< 0.005	< 0.005	**0.004 J**	< 0.025	**0.062**	< 0.005
WL-111	0	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	**0.034**	< 0.005
WL-112	0	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.005
WL-113	45	**0.008**	**0.067**	**0.23**	**0.037**	**0.016**	**0.015**	< 0.025	**0.019 J**	< 0.005
WL-114	0	< 0.005	< 0.005	**0.037**	< 0.005	< 0.005	**0.042**	< 0.025	< 0.025	< 0.005
WL-115	5	**29 Y**	**20 Y**	**200 Y**	**26 Y**	< 5.0	< 5.0	< 25	< 25	**2.70 U**
	38	< 0.005	< 0.005	**0.0066**	**0.0027 J**	< 0.005	< 0.005	< 0.025	**0.024 J**	< 0.005
WL-116	0	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.005
WL-119	50	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.25	**0.032**	< 0.005
	50 DUP (F)	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	**0.006**	< 0.25	**0.024 J**	< 0.005
AREA 2										
WL-203	0	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.005
WL-206	0	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.005
WL-208	15	< 2.50	< 2.50	**1.30 J**	< 2.50	< 2.50	< 2.50	**52**	**19 U**	< 2.50
	20[1]	**8300 Y**	**300 JY**	**1800 Y**	**500 JY**	< 500	< 500	< 2500	**1400 U**	**240 JY**
	28	< 0.50	**0.29 J**	**1.4**	**0.46 J**	< 0.50	< 0.50	**8.4**	**3.30 U**	**0.47 J**
WL-209	0	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	**0.0065**	< 0.025	**0.038**	< 0.005
WL-210	0	< 0.005	< 0.005	**0.012**	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.005
	15	**140 Y**	**32 Y**	**120 Y**	**46 Y**	< 25	< 25	**50 JY**	**42 U**	**7.6 JY**
WL-213	0	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.005
	25	**3.1**	**0.16 J**	**0.87**	**0.23 J**	< 0.50	< 0.50	**0.58 J**	**2.80 U**	**0.22 J**
WL-214	25	< 0.50	**1.6**	**0.64**	< 0.50	**7.8**	**0.75**	< 2.5	**2.40 U**	**0.38 J**
WL-215	0	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.005
WL-218	0	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.005
	25	**0.13 J**	< 0.50	**0.72**	< 0.50	< 0.50	**0.95**	< 2.5	**1.0 U**	**0.15 J**
WL-221	35	< 0.005	< 0.005	< 0.005	< 0.005	**0.003 J**	< 0.005	< 0.025	**0.026**	**0.004 J**
WL-222	0	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.005
	30	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	**0.033**	< 0.005
	30 DUP (F)	< 0.005	**0.004 J**	< 0.005	< 0.005	**0.005**	**0.008**	< 0.025	**0.046**	**0.011**
WL-226	43	< 0.005	**0.008**	< 0.005	**0.007**	< 0.005	< 0.005	< 0.025	**0.011 U**	< 0.005
WL-227	40	< 0.005	**0.017**	**0.067**	**0.018**	**0.016**	**0.007**	< 0.025	**0.031 U**	< 0.005
WL-230	16	< 100	< 100	< 100	< 100	**180 Y**	**2100 Y**	< 500	< 500	< 100
	35	< 2.50	< 2.50	< 2.50	< 2.50	< 2.50	< 2.5	< 12	**62**	< 2.5
WL-231	0	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.005
WL-235	0	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.025	< 0.025	< 0.005

[1] = Analytical data represents contents from a severely damaged 5-gallon container brought up with the augers during drilling operation.
-- = Not reported
DUP (F) = Field duplicate
ppm = parts per million
< = Result reported below detection limit.
Bolded numbers indicate result reported above detection limit.
J = Estimated value. Result was below the reporting limit.
U = Not detected. Method blank contained a trace of either Acetone or Methylene Chloride; results for Acetone or Methylene Chloride less than ten times the method blank level are reported as not detected.
Y = Estimated value. All surrogates were diluted beyond detection limits.

Benzene was only detected in WL-103-15 (0.002 J ppm), WL-104-25 (0.008 J ppm), and WL-208-20 (120 J
1,2-Dichlorobenzene was only detected in WL-101-5 (0.001 J ppm), WL-113-45 (0.004 J ppm), and WL-21
1,1-Dichloroethane was only detected in WL-208-20 (270 JY ppm) and WL-213-25 (0.11 J ppm).
Trichloroethene was only detected in WL-210-15 (6.0 JY ppm).
4-Methyl-2-Pentanone was only detected in WL-208-15 (7.70 J ppm), WL-208-28 (0.97 J ppm), and WL-21

Table B-16 : Soil Analytical Results - Semivolatile Organic Compounds

Boring	Depth (feet)	Benzoic Acid Result (ppm)	1,4-Dichlorobenzene Result (ppm)	Pyrene Result (ppm)	Naphthalene Result (ppm)	2-Methylnaphthalene Result (ppm)	Fluoranthene Result (ppm)	Phenanthrene Result (ppm)	Phenol Result (ppm)	4-Methylphenol Result (ppm)	Butyl benzyl phthalate Result (ppm)	Diethylphalate Result (ppm)	Di-n-butylphthalate Result (ppm)	Di-n-octylphthalate Result (ppm)	Bis(2-Ethylhexyl)phthalate Result (ppm)
AREA 1															
WL-101	5	--	< 0.67	**0.09 J**	< 0.67	--	**0.13 J**	< 0.67	< 0.67	--	**0.23 J**	< 0.67	< 0.67	**0.17 J**	**3.60**
	25	--	< 0.33	< 0.33	< 0.33	--	< 0.33	< 0.33	< 0.33	--	< 0.33	< 0.33	< 0.33	< 0.33	**0.78**
WL-103	15	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
	25	--	--	--	--	--	--	--		--	--	--	--	--	--
WL-104	25	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	**0.19 J**
	35	--	--	--	--	--	--	--	--	--	--	--	--	--	--
WL-106	0	< 4.20	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	**3.00**	**7.80**
	30	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
	30 DUP (F)	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	**0.092 J**	< 0.33	< 0.33	< 0.33	**0.39**
WL-108	30	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
WL-111	0	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
WL-112	0	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
WL-113	45	< 0.83	**0.039 J**	**0.034 J**	**0.13 J**	**0.097 J**	**0.035 J**	**0.044 J**	< 0.33	< 0.33	**6.4**	**0.033 J**	**0.30 J**	**0.32 J**	**25**
WL-114	0	< 4.20	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	**7.50**
WL-115	5	< 8.30	< 3.30	**0.70 J**	**4.70**	**4.40**	**0.73 J**	**0.91 J**	< 3.30	< 3.30	**180**	< 3.30	**10**	**3.70**	**23**
	38	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	**0.069 J**	< 0.33	< 0.33	< 0.33	**0.12 J**
WL-116	0	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
WL-119	50	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	**1.6**
	50 DUP (F)	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
AREA 2															
WL-203	0	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
WL-206	0	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
WL-208	15	**0.36 J**	**0.14 J**	< 0.33	**0.82**	**0.19 J**	< 0.33	**0.073 J**	**0.90**	**0.16 J**	**0.52**	**0.082 J**	**0.20 J**	< 0.33	**2.20**
	20*	< 1700	< 670	< 670	< 670	< 670	< 670	< 670	< 670	< 670	**5100 Y**	< 670	< 670	< 670	**180 JY**
	28	**0.15 J**	< 0.33	< 0.33	**0.095 J**	< 0.33	< 0.33	< 0.33	**0.41**	**0.078 J**	< 0.33	0.053 J	< 0.33	< 0.33	**0.26 J**
WL-209	0	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	**1.00**
WL-210	0	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	**0.59**
	15	< 42	< 17	< 17	**6.90 JY**	**2.90 JY**	< 17	< 17	**9.0 JY**	**5.80 JY**	< 17	< 17	< 17	< 17	**62 Y**
WL-213	0	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
	25	**0.79 J**	< 0.33	< 0.33	**0.034 J**	< 0.33	< 0.33	< 0.33	**0.75**	**9.8**	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
WL-214	25	< 25	< 10	< 10	< 10	< 10	< 10	< 10	< 10 R	< 10 R	< 10	< 10	< 10	< 10	**63**
WL-215	0	< 42	< 17	< 17	< 17	< 17	< 17	< 17	< 17	< 17	< 17	< 17	< 17	**12 JY**	**77 Y**
WL-218	0	< 1.70	< 0.67	< 0.67	< 0.67	< 0.67	**0.92**	< 0.67	< 0.67	< 0.67	< 0.67	< 0.67	< 0.67	< 0.67	< 0.67
	25	< 33	< 13	< 13	**10 J**	< 13	< 13	< 13	< 13	< 13	< 13	< 13	< 13	< 13	**91**
WL-221	35	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	**0.18 J**
WL-222	0	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	**0.40**
	30	< 0.83	< 0.33	< 0.33	**0.041 J**	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	**0.15 J**
	30 DUP (F)	< 0.83	< 0.33	< 0.33	**0.18 J**	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	**0.24 J**
WL-226	43	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	**0.26 J**
WL-227	40	< 0.83	< 0.33	< 0.33	**0.098 J**	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	**0.15 J**	**4.9**
WL-230	16	< 170	**530 Y**	< 67	< 67	< 67	< 67	< 67	< 67	< 67	< 67	< 67	< 67	< 67	**47 JY**
	35	< 0.83	**0.062 J**	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	**0.11 J**
WL-231	0	< 0.83	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33	< 0.33
WL-235	0	< 4.20	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	< 1.70	**8.00**

* = Analytical data represents contents from a severely damaged 5-gallon container brought up with the augers during drilling operation.
-- = Not reported.
DUP (F) = Field duplicate
ppm = parts per million
< = Result reported below detection limit.
Bolded numbers indicate result reported above detection limit.
J = Estimated value. Result was below the reporting limit.
R = Unusable negative results. 1 of 3 acid extractable surrogate recoveries were outside control limits and below 10%.
Y = Estimated value. All surrogates were diluted beyond detection limits.

Benzyl alcohol was only detected in WL-208-28 (0.079 J ppm)
1,2-Dichlorobenzene was only detected in WL-208-15 (0.29 J ppm) and WL-208-28 (0.074 J ppm).
Benzo(a)anthracene was only detected in Erosional Sediment Sample 1 (0.067 J ppm)
Benzo(b)fluoranthene was only detected in Erosional Sediment Sample 1 (0.093 J ppm) and Erosional Sediment Sample 3 (0.048 J ppm)
Benzo(k)fluoranthene was only detected in Erosional Sediment Sample 1 (0.069 J ppm) and Erosional Sediment Sample 3 (0.040 J ppm)
Benzo(g,h,i)perylene was only detected in Erosional Sediment Sample 1 (0.061 J ppm)
Benzo(a)pyrene was only detected in Erosional Sediment Sample 1 (0.089 J ppm) and Erosional Sediment Sample 3 (0.035 J ppm)
Chrysene was only detected in Erosional Sediment Sample 1 (0.078 J ppm) and Erosional Sediment Sample 3 (0.038 J ppm)
Flourene was only detected in WL-115-5 (0.36 J ppm)
Ideno(1,2,3-c,d)pyrene was only detected in Erosional Sediment Sample 1 (0.062 J ppm)
2-Methylphenol was only detected in WL-208-15 (0.063 J ppm) and WL-213-25 (0.17 J ppm)
2,4-Dimethylphenol was only detected in WL-208-28 (0.12 J ppm).
Pentachlorophenol was only detected in WL-208-28 (0.085 J ppm)

Table B-17 : Soil Analytical Results - Pesticides and Polychlorinated Biphenyls

		Pesticides								Polychlorinated Biphenyls		
Boring	Depth (feet)	4,4'-DDD Result (ppm)	4,4'-DDE Result (ppm)	4,4'-DDT Result (ppm)	Aldrin Result (ppm)	beta-BHC Result (ppm)	Dieldrin Result (ppm)	Endosulfan I Result (ppm)	Endrin Result (ppm)	Aroclor 1242 Result (ppm)	Aroclor 1248 Result (ppm)	Aroclor 1254 Result (ppm)
AREA 1												
WL-101	5	**0.0014**	**0.00072**	**0.0085**	< 0.00034	< 0.00034	**0.0012**	**0.0011**	**0.0039**	< 0.017	< 0.017	< 0.017
	25	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
WL-103	15	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
	25	--	--	--	--	--	--	--	--	--	--	--
WL-104	25	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
	35	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
WL-106	0	< 0.0033	< 0.0033	< 0.0033	< 0.0017	< 0.0017	< 0.0033	< 0.0017	< 0.0033	< 0.083	< 0.083	< 0.083
	30	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
	30 DUP (F)	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
WL-108	30	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
WL-111	0	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
WL-112	0	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
WL-113	45	**0.00079**	**0.00088**	**0.0018**	**0.0011**	< 0.00034	**0.00092**	< 0.00034	< 0.00068	**0.033**	< 0.017	< 0.017
WL-114	0	< 0.0033	< 0.0033	< 0.0033	< 0.0017	< 0.0017	< 0.0033	< 0.0017	< 0.0033	< 0.083	< 0.083	**1.10**
WL-115	5	**0.015 Y**	< 0.0068	**0.063 Y**	**0.16 Y**	**0.017 Y**	**0.042 Y**	< 0.0034	**0.0093 Y**	**2.6 Y**	< 0.17	< 0.17
	38	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
WL-116	0	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
WL-119	50	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	**0.0096**	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
	50 DUP (F)	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	**0.010**	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
AREA 2												
WL-203	0	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
WL-206	0	< 0.0068	< 0.0068	**0.0068**	< 0.0034	< 0.0034	< 0.0068	< 0.0034	< 0.0068	< 0.17	< 0.17	< 0.17
WL-208	15	--	--	--	--	--	--	--	--	< 0.017	< 0.017	**0.18**
	20[1]	--	--	--	--	--	--	--	--	< 0.34	< 0.34	< 0.34
	28	--	--	--	--	--	--	--	--	< 0.017	< 0.017	< 0.017
WL-209	0	< 0.0033	< 0.0033	< 0.0033	**0.0017**	< 0.0017	< 0.0033	< 0.0017	< 0.0033	< 0.083	< 0.083	**1.60**
WL-210	0	< 0.0033	< 0.0033	< 0.0033	< 0.0017	< 0.0017	< 0.0033	< 0.0017	< 0.0033	< 0.083	< 0.083	**1.60**
	15	--	--	--	--	--	--	--	--	< 0.34	< 0.34	< 0.34
WL-213	0	< 0.0068	< 0.0068	< 0.0068	< 0.0034	< 0.0034	< 0.0068	< 0.0034	< 0.0068	< 0.17	< 0.17	< 0.17
	25	< 0.00068	< 0.00068	< 0.00068	**0.0011**	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
WL-214	25	< 0.0068	**0.0078**	< 0.0068	**0.009**	< 0.0034	< 0.0068	**0.011**	< 0.0068	< 0.017	**0.22**	< 0.017
WL-215	0	< 0.068	< 0.068	< 0.068	< 0.034	< 0.034	< 0.068	< 0.034	< 0.068	< 1.70	< 1.70	< 1.70
WL-218	0	< 0.0068	< 0.0068	< 0.0068	< 0.0034	< 0.0034	< 0.0068	< 0.0034	< 0.0068	< 0.17	< 0.17	< 0.17
	25	< 0.034	< 0.034	< 0.034	**0.47 Y**	**0.028 Y**	< 0.034	< 0.017	**0.18 Y**	< 0.85	**18 Y**	< 0.85
WL-221	35	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
WL-222	0	**0.00078**	< 0.00068	**0.00087**	**0.00096**	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
	30	< 0.00068	< 0.00068	< 0.00068	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
	30 DUP (F)	< 0.00068	< 0.00068	< 0.00068	**0.00044**	< 0.00034	< 0.00068	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
WL-226	43	< 0.00068	< 0.00068	**0.0021**	< 0.00034	< 0.00034	< 0.00068	< 0.00034	< 0.00068	**0.067**	**0.017**	< 0.017
WL-227	40	< 0.00068	**0.0021**	**0.0079**	**0.0061**	< 0.00034	< 0.00068	< 0.00034	**0.0027**	**0.45**	< 0.017	< 0.017
WL-230	16	< 0.0068	< 0.0068	**0.018**	**0.051**	**0.0044**	< 0.0068	< 0.0034	< 0.0068	**1.00**	< 0.17	< 0.17
	35	< 0.00068	< 0.00068	< 0.00068	**0.0013**	< 0.00034	**0.0012**	< 0.00034	< 0.00068	< 0.017	< 0.017	< 0.017
WL-231	0	< 0.0068	< 0.0068	< 0.0068	< 0.0034	< 0.0034	< 0.0068	< 0.0034	< 0.0068	< 0.17	< 0.17	< 0.17
WL-235	0	**0.0076**	< 0.0068	**0.0093**	< 0.0034	< 0.0034	< 0.0068	< 0.0034	< 0.0068	< 0.17	< 0.17	< 0.17

[1] = Analytical data represents contents from a severely damaged 5-gallon container brought up with the augers during drilling operation.
-- = Not reported. Since pesticides and polychlorinated biphenyls were not detected for contingency sample WL-103-15, pesticides and polychlorinated biphenyls were not analyzed for sample WL-103-25. Additionally, due to laboratory error pesticides were not analyzed for samples corresponding to boring location WL-208 and sample WL-210-15.
DUP (F) = Field duplicate
ppm = parts per million
< = Result reported below detection limit.
Bolded numbers indicate result reported above appropriate detection limit.
Y = Estimated value. All surrogates diluted beyond detection limits

Chlordane (Technical) was only detected in WL-104-25 (0.015 ppm).
Endosulfan II was only detected in WL-101-5 (0.00087 ppm) and WL-115-5 (0.011 Y ppm).
Endosulfan Sulfate was only detected in WL-218-25 (0.11 Y ppm) and WL-226-43 (0.0015 ppm).
Methoxychlor was only detected in WL-227-40 (0.0057 ppm).

Table B-18 : Soil Analytical Results - Background Priority Pollutant Metals

Sample Location	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Zinc (Zn)
	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)
Barrow Pit - loess	**5.2 Z**	**0.4**	*< 0.50*	**8.9**	**13**	**9.8**	*< 0.10*	**16**	*< 0.25*	**41**
Barrow Pit - shale	*< 0.5*	*< 0.25*	*< 0.50*	**12**	**16**	**7.5**	*< 0.10*	**3.6**	*< 0.25*	**2.1**
Farmer's Field	**3.4 Z**	**0.5**	*< 0.50*	**9.4**	**13**	**16**	*< 0.10*	**14**	*< 0.25*	**48**
McLaren/Hart Shop	**2.7 Z**	**0.31**	*< 0.50*	**8.6**	**11**	**32**	*< 0.10*	**11**	*< 0.25*	**47**

< = Result reported below reporting limit.
ppm = parts per million
Z = Estimated value. Analyte percent recoveries were outside the control limits for the matrix spike/matrix spike duplicate (MS/MSD) samples.
Bold numbers indicate result reported above appropriate reporting limit.

Appendix C :

Radiological and Non-Radiological Analytical Results For Groundwater Samples

Table C-1 : Gross Alpha - Unfiltered Grab Groundwater Samples

Monitoring Well	Gross Alpha		
	Result	+/- Sigma	MDA
Shallow Depth Wells			
S-51	< MDA	--	4.64
S-53	**5.76**		4.49
S-61	**5.39**		4.63
S-80	**285**		46
S-82	< MDA	--	13.3
S-84	< MDA	--	7.3
S-88	**52.5**		9.7
MW-F1S	< MDA	--	9.32
MW-101	< MDA	--	6.03
MW-102	< MDA	--	4.16
MW-102 DUP (F)	< MDA	--	4.7
MW-103	**13.7**		11.8
MW-104	< MDA	--	14.4
MW-106	< MDA	--	12
MW-107	< MDA	--	7.16
MW-F3	< MDA	--	10.7
Intermediate Depth Wells			
I-50	< MDA	--	7.47
I-62	< MDA	--	4.7
I-65	< MDA	--	2.06
I-66	< MDA	--	5.86
I-67	< MDA	--	7.55
I-68	< MDA	--	11.7
I-73	< MDA	--	7.24
Deep Depth Wells			
D-81	< MDA	--	2.79
D-81 DUP (F)	< MDA	--	2.83
D-83	< MDA	--	3.29
D-85	< MDA	--	11.2
D-87	< MDA	--	8.14
D-93	< MDA	--	5.4
MW-F1D	< MDA	--	8.5
Quarry Wells			
1201	< MDA	--	5.54
1204	**7.78**		4.46
1206	**138**		20

All values expressed as pCi/L, unless otherwise indicated.
DUP (F) = Field duplicate
MDA = Minimum Detectable Activity
Bold numbers indicate results above the Minimum Detectable Activity
Unfiltered grab groundwater samples were collected using a bailer. No purging was performed prior to sample collection since the samples were collected solely for characterization of the groundwater prior to well development.

Table C-2 : Filtered Groundwater Analytical Data For Three Existing Groundwater Wells That Exceeded Metropolitan St. Louis Sewer District (MSD) Gross Alpha Criteria

Monitoring Well	Uranium-238			Uranium-234			Thorium-230			Radium-226		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-80	**0.15**		*0.08*	**0.74**		*0.08*	**0.19**		*0.16*	**0.27**		*0.21*
S-88	**23.1**		*0.2*	**28.0**		*0.2*	*< MDA*	--	*0.32*	**0.50**		*0.41*
S-88 DUP (L)	**0.63**		*0.22*	**0.84**		*0.19*	*< MDA*	--	*0.38*	*< MDA*	--	*0.58*
1206	**0.27**		*0.05*	**0.42**		*0.05*	**0.35**		*0.12*	**1.43**		*0.26*

Monitoring Well	Uranium-235/236		
	Result	+/- Sigma	MDA
S-80	**0.062**		*0.056*
S-88	**1.59**		*0.26*
S-88 DUP (L)	**0.12**		*0.11*
1206	**0.12**		*0.06*

Monitoring Well	Thorium-232			Thorium-228		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-80	*< MDA*	--	*0.139*	*< MDA*	--	*0.174*
S-88	*< MDA*	--	*0.318*	*< MDA*	--	*0.400*
S-88 DUP (L)	*< MDA*	--	*0.298*	*< MDA*	--	*0.524*
1206	*< MDA*	--	*0.123*	*< MDA*	--	*0.223*

Monitoring Well	Gross Alpha		
	Result	+/- Sigma	MDA
S-80	*< MDA*	--	*10.1*
S-88	**10.3**		*9.0*
S-88 DUP (L)	*< MDA*	--	*11.1*
1206	*< MDA*	--	*9.34*

All Values expressed as pCi/L. unless otherwise noted.
DUP (L) = Laboratory duplicate
MDA = Minimum Detectable Activity
S = Shallow Depth Monitoring Well
1206 = Quarry well
Bold numbers indicate result above the Minimum Dectectable Activity

Table C-3 : Groundwater Analytical Results - Gross Alpha and Uranium-238 Decay Series

Monitoring Well	Date	Filtered	Gross Alpha Result	Gross Alpha +/- Sigma	Gross Alpha MDA	Uranium-238 Result	Uranium-238 MDA	Uranium-238 +/- Sigma	Thorium-234 Result	Thorium-234 MDA	Thorium-234 +/- Sigma	Uranium-234 Result	Uranium-234 MDA	Uranium-234 +/- Sigma	Thorium-230 Result	Thorium-230 MDA	Thorium-230 +/- Sigma	Radium-226 Result	Radium-226 MDA	Radium-226 +/- Sigma	Lead-214 Result	Lead-214 MDA	Lead-214 +/- Sigma	Bismuth-214 Result	Bismuth-214 MDA	Bismuth-214 +/- Sigma	Lead-210 Result	Lead-210 MDA	Lead-210 +/- Sigma
Shallow Depth Wells																													
S-1	Nov-95	Filtered	—	—	—	2.25	0.27		MDA	71.65		3.35			1.19			MDA	20.7		MDA	18.63		MDA	20.67	—	MDA	108	—
S-1	Nov-95	unfiltered	—	—	—	2.7	0.19		MDA	145.2		2.97			MDA	0.64		MDA	29.4		MDA	29.95		MDA	29.39	—	MDA	172	—
S-1	Feb-96	Filtered	—	—	—	1.95	0.14		MDA	240.7		3.35			0.29			MDA	33		—	—	—	MDA	32.98	—	MDA	1290	—
S-1	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	0.96			0.52			—	—	—	—	—	—	—	—	—
S-1	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	0.39			0.1			—	—	—	—	—	—	—	—	—
S-1	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.43			—	—	—	—	—	—	—	—	—
S-1 DUP (F)	Nov-95	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-1 DUP (F)	Nov-95	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-1 DUP (F)	Feb-96	Filtered	—	—	—	—	—	—	MDA	187		—	—	—	—	—	—	28.6			—	—	—	MDA	27.52	—	MDA	299	—
S-1 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	0.72			0.51			—	—	—	—	—	—	—	—	—
S-1 DUP (F)	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—		—			—	—	—	—	—	—	—	—	—
S-1 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-5	Nov-95	Filtered	—	—	—	MDA	0.35		178	—		0.58			2.79			MDA	32.5		MDA	30.55		MDA	32.5	—	MDA	209	—
S-5	Nov-95	unfiltered	—	—	—	0.35	0.33		MDA	103.6		0.63			xx			MDA	31.5		MDA	27.28		MDA	31.49	—	MDA	118	—
S-5	Feb-96	Filtered	—	—	—	MDA	0.117		MDA	344.4		0.2			0.58			MDA	41.7		—	—	—	MDA	41.66	—	MDA	3960	—
S-5	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	1.76			0.6			—	—	—	—	—	—	—	—	—
S-5	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	MDA	0.13		MDA	0.13		—	—	—	—	—	—	—	—	—
S-5	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.23			—	—	—	—	—	—	—	—	—
S-8	Nov-95	Filtered	—	—	—	1.28	0.34		MDA	112		1.69			xx			MDA	35.7		MDA	31.15		MDA	35.74	—	MDA	222	—
S-8	Nov-95	unfiltered	—	—	—	1.7	0.21		MDA	343.3		2.01			0.53			MDA	57.8		MDA	43.15		MDA	57.81	—	MDA	3680	—
S-8	Feb-96	Filtered	—	—	—	1.08	0.24		MDA	78.92		1.47			0.48			MDA	32.2		—		—	MDA	32.19	—	MDA	163	—
S-8	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	1.58			0.91			—	—	—	—	—	—	—	—	—
S-8	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	0.27			0.21			—	—	—	—	—	—	—	—	—
S-8	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.37			—	—	—	—	—	—	—	—	—
S-10	Nov-95	Filtered	—	—	—	1.08			MDA	157.1		1.31			MDA	6.7		MDA	35.5		56.7			MDA	35.49	—	MDA	221	—
S-10	Nov-95	unfiltered	—	—	—	0.95			MDA	98.05		1.28			MDA	5.73		MDA	38.8		MDA	38.89		MDA	38.77	—	MDA	211	—
S-10	Feb-96	Filtered	—	—	—	0.76			MDA	103.3		1.14			0.46			MDA	29.2		—	—	—	MDA	29.24	—	MDA	191	—
S-10	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	MDA	13.7		MDA	0.37		—	—	—	—	—	—	—	—	—
S-10	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	0.44			0.32			—	—	—	—	—	—	—	—	—
S-10	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.34			—	—	—	—	—	—	—	—	—
S-61	Nov-95	Filtered	—	—	—	0.62			MDA	143.6		1.51			1.62			MDA	25.7		MDA	22.43		MDA	25.67	—	MDA	145	—
S-61	Nov-95	unfiltered	—	—	—	0.76			MDA	139.4		1.12			2.3			MDA	30.6		MDA	26.53		MDA	30.61	—	MDA	152	—
S-61	Feb-96	Filtered	—	—	—	0.9			MDA	201.4		1.36			1.39			MDA	28		—	—	—	MDA	28.02	—	MDA	332	—
S-61	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	0.97			0.71			—	—	—	—	—	—	—	—	—
S-61	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	0.49			0.29			—	—	—	—	—	—	—	—	—
S-61	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.29			—	—	—	—	—	—	—	—	—
S-80	Nov-95	Filtered	—	—	—	0.49			MDA	145.5		0.88			0.61			34.9			34			MDA	39.54	—	MDA	165	—
S-80	Nov-95	unfiltered	—	—	—	1.69			MDA	152.3		2.72			MDA	2.09		MDA	31.3		MDA	26.88		MDA	31.3	—	MDA	186	—
S-80	Feb-96	Filtered	—	—	—	0.85			MDA	143.5		0.73			0.38			130			—	—	—	MDA	51.57	—	MDA	163	—
S-80	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	5.29			3.38			—	—	—	—	—	—	—	—	—
S-80	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-80	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-80 DUP (F)	Nov-95	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-80 DUP (F)	Nov-95	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-80 DUP (F)	Feb-96	Filtered	—	—	—	—	—	—	MDA	258.2		—	—	—	—	—	—	MDA	31		—	—	—	MDA	30.98	—	MDA	429	—
S-80 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-80 DUP (F)	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-80 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-82	Nov-95	Filtered	—	—	—	3.11			MDA	73.47		5.17			1.04			MDA	12.8		MDA	11.16		MDA	12.78	—	MDA	57.2	—
S-82	Nov-95	unfiltered	—	—	—	2.49			MDA	75.49		4.48			MDA	1.91		MDA	25.1		MDA	19.25		MDA	25.09	—	MDA	143	—
S-82	Feb-96	Filtered	—	—	—	1.86			MDA	306.1		2.51			0.93			MDA	39.2		—	—	—	MDA	39.23	—	MDA	3660	—
S-82	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	0.76			1.09			—	—	—	—	—	—	—	—	—
S-82	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	0.25			0.88			—	—	—	—	—	—	—	—	—
S-82	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1.39			—	—	—	—	—	—	—	—	—
S-82	May-97	Filtered	1.24			1.13			—	—		1.5			0.18			1.07			MDA	24.9		MDA	31	—	MDA	402	—
S-82	May-97	unfiltered	1.35			1.48			—	—		1.73			0.55			1.06			MDA	28.2		MDA	35.5	—	MDA	199	—
S-82	May-97	unfiltered	1.23			1.37			—	—	—	1.21			0.73			0.76			MDA	30.1		MDA	31.4	—	MDA	222	—
S-84	Nov-95	Filtered	—	—	—	0.41			MDA	129.4		0.22			MDA	0.65		MDA	28.8		MDA	22.35		MDA	28.81	—	MDA	136	—
S-84	Nov-95	unfiltered	—	—	—	0.36			MDA	146.5		0.55			1.31			MDA	30.3		MDA	25.03		MDA	30.28	—	MDA	181	—
S-84	Feb-96	Filtered	—	—	—	0.63			MDA	189.2		0.5			0.37			MDA	28.7		—	—	—	MDA	28.67	—	MDA	309	—
S-84	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	0.77			0.64			—	—	—	—	—	—	—	—	—
S-84	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	0.35			0.34			—	—	—	—	—	—	—	—	—
S-84	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	0.34			—	—	—	—	—	—	—	—	—
S-84 DUP (F)	Nov-95	Filtered	—	—	—	—	—	—	MDA	228.5		—	—	—	—	—	—	MDA	23.2		MDA	22.21		MDA	23.19	—	MDA	1300	—
S-84 DUP (F)	Nov-95	unfiltered	—	—	—	—	—	—	MDA	146.9		—	—	—	—	—	—	MDA	33.5		MDA	25.98		MDA	33.5	—	MDA	196	—
S-84 DUP (F)	Feb-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-84 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-84 DUP (F)	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
S-84 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Table C-3 : Groundwater Analytical Results - Gross Alpha and Uranium-238 Decay Series

Monitoring Well	Date	Filtered	Gross Alpha			Uranium-238			Thorium-234			Uranium-234			Thorium-230			Radium-226			Lead-214			Bismuth-214			Lead-210		
			Result	+/- Sigma	MDA	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma
MW-101	Nov-95	Filtered	----	----		1.58			MDA	131.1		3.92			0.96			MDA	26.2		MDA	20.46		MDA	26.19	----	MDA	137	----
MW-101	Nov-95	unfiltered	----	----	----	1.41			MDA	75.49		1.43			0.49			MDA	27.3		MDA	20.49		MDA	27.28	----	156		
MW-101	Feb-96	Filtered	----	----	----	0.95			MDA	77.63		1.69			MDA	0.15		MDA	34.7		----	----	----	MDA	34.66	----	MDA	118	----
MW-101	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	0.69			0.49			----	----	----	----	----	----	----	----	----
MW-101	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.15			0.22			----	----	----	----	----	----	----	----	----
MW-101	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.18			----	----	----	----	----	----	----	----	----
MW-107	Nov-95	Filtered	----	----	----	0.68			MDA	109.3		1.03			2.63			33.7			29.2			MDA	18.2	----	MDA	174	----
MW-107	Nov-95	unfiltered	----	----	----	MDA	0.99		MDA	136.7		-1.12			1.61			36.8			36.1			MDA	19.47	----	MDA	132	----
MW-107	Feb-96	Filtered	----	----	----	0.24			MDA	162.1		0.18			0.77			MDA	50.8		----	----	----	MDA	50.8	----	MDA	231	----
MW-107	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	0.6			0.78			----	----	----	----	----	----	----	----	----
MW-107	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	MDA	0.19		MDA			----	----	----	----	----	----	----	----	----
MW-107	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.56			----	----	----	----	----	----	----	----	----
MW-107 DUP (F)	Nov-95	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
MW-107 DUP (F)	Nov-95	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
MW-107 DUP (F)	Feb-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
MW-107 DUP (F)	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
MW-107 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	MDA	0.26		MDA	0.12		----	----	----	----	----	----	----	----	----
MW-107 DUP (F)	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.71			----	----	----	----	----	----	----	----	----
MW-F3	Nov-95	Filtered	----	----	----	MDA	0.28		MDA	195.9		0.41			MDA	6.6		MDA	23.4		MDA	23.87		MDA	23.36	----	MDA	301	----
MW-F3	Nov-95	unfiltered	----	----	----	1.79			MDA	360.8		2.03			MDA	6.28		MDA	54		MDA	42.93		MDA	53.98	----	MDA	3570	----
MW-F3	Feb-96	Filtered	----	----	----	MDA	0.31		MDA	259.1		0.78			0.54			MDA	33.3		----	----	----	MDA	33.33	----	MDA	1380	----
MW-F3	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	1.81			1.05			----	----	----	----	----	----	----	----	----
MW-F3	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	MDA	0.11		0.5			----	----	----	----	----	----	----	----	----
MW-F3	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.44			----	----	----	----	----	----	----	----	----
PZ-114-AS	Nov-95	Filtered	----	----	----	2.44			MDA	76.03		2.86			2.67			MDA	24.6		MDA	18.48		MDA	24.62	----	MDA	104	----
PZ-114-AS	Nov-95	unfiltered	----	----	----	2.81			MDA	73.95		3.45			2.3			MDA	27.2		MDA	23.29		MDA	27.23	----	MDA	137	----
PZ-114-AS	Feb-96	Filtered	----	----	----	2.08			MDA	151.8		2.25			0.52			MDA	35.8		----	----	----	MDA	35.73	----	MDA	176	----
PZ-114-AS	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	1.35			0.68			----	----	----	----	----	----	----	----	----
PZ-114-AS	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.69			0.51			----	----	----	----	----	----	----	----	----
PZ-114-AS	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.17			----	----	----	----	----	----	----	----	----
Intermediate Depth Wells																													
I-2	Nov-95	Filtered	----	----	----	1.62			MDA	108.1		3.27			MDA	0.49		MDA	12.9		MDA	11.8		MDA	12.88	----	MDA	172	----
I-2	Nov-95	unfiltered	----	----	----	2.11			MDA	131		2.87			1.04			MDA	13.6		MDA	13.19		MDA	13.55	----	MDA	433	----
I-2	Feb-96	Filtered	----	----	----	0.55			MDA	155.4		0.89			0.4			MDA	36.6		----	----	----	MDA	36.61	----	MDA	202	----
I-2	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	0.34			1.69			----	----	----	----	----	----	----	----	----
I-2	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.31			1.17			----	----	----	----	----	----	----	----	----
I-2	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1.44			----	----	----	----	----	----	----	----	----
I-2	May-97	Filtered	1.52			0.14			----	----	----	0.26			0.38			0.98			MDA	28.1		MDA	34.1	----	MDA	230	----
I-2	May-97	unfiltered	MDA		1.6	0.27			----	----	----	0.45			0.29			1.05			MDA	24.7		MDA	34.4	----	MDA	240	----
I-2-DUP	May-97	Filtered	0.99			0.2			----	----	----	0.38			0.13			0.82			MDA	30.4		MDA	32.5	----	MDA	77000	----
I-2-DUP	May-97	unfiltered	1.23			0.31			----	----	----	1.13			0.14			1.09			MDA	29.8		MDA	26.5		MDA	171000	
I-4	Nov-95	Filtered	----	----		MDA	0.17		MDA	300.9		0.22			MDA	2.04		MDA	41.4		MDA	36.26		MDA	41.35	----	MDA	3070	----
I-4	Nov-95	unfiltered	----	----	----	MDA	0.14		MDA	66.91		MDA	0.18		MDA	1.84		MDA	25.4		MDA	22.05		MDA	25.39	----	MDA	132	----
I-4	Feb-96	Filtered	----	----	----	0.12			MDA	155.6		0.17			0.64			MDA	37.8		----	----		MDA	37.84	----	MDA	214	----
I-4	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	0.64			2.41			----	----	----	----	----	----	----	----	----
I-4	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.65			0.87			----	----	----	----	----	----	----	----	----
I-4	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1.5			----	----	----	----	----	----	----	----	----
I-4	May-97	Filtered	MDA		0.98	0.04			----	----	----	0.11			0.005			0.81			MDA	26.3		MDA	31.8	----	MDA	176	----
I-4	May-97	unfiltered	MDA		0.44	0.078			----	----	----	0.1			0.18			1.04			MDA	27.8		MDA	35.1	----	MDA	71400	----
I-4 DUP (F)	Nov-95	Filtered	----	----	----	----	----	----	MDA	221.2		----	----	----	----	----	----	MDA	28.3		MDA	26.9		MDA	28.28	----	MDA	1300	----
I-4 DUP (F)	Nov-95	unfiltered	----	----	----	----	----	----	MDA	140.4		----	----	----	----	----	----	MDA	29.6		MDA	25.38		MDA	29.65	----	MDA	141	----
I-4 DUP (F)	Feb-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
I-4 DUP (F)	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
I-4 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
I-4 DUP (F)	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
I-7	Nov-95	Filtered	----	----	----	1.92			MDA	187.6		3.67			MDA	2.42		MDA	24.7		MDA	20.34		MDA	24.7	----	MDA	274	----
I-7	Nov-95	unfiltered	----	----	----	3.62			MDA	310.1		3.83			1.22			MDA	42.7		MDA	38.33		MDA	42.7	----	MDA	3420	----
I-7	Feb-96	Filtered	----	----	----	1.51			MDA	323		2.44			0.29			MDA	47.8		----		----	MDA	47.77	----	MDA	4180	----
I-7	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	1.06			0.69			----		----	----	----	----	----	----	----
I-7	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.32			0.18			----		----	----	----	----	----	----	----
I-7	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.35			----		----	----	----	----	----	----	----
I-9	Nov-95	Filtered	----	----	----	1.78			MDA	55.32		2.89			MDA	1.04		MDA	12.7		MDA	11.12		MDA	12.72	----	MDA	54.5	----
I-9	Nov-95	unfiltered	----	----	----	2.54			MDA	203		3.77			1.54			MDA	25.1		MDA	23.3		MDA	25.14	----	MDA	2080	----
I-9	Feb-96	Filtered	----	----	----	2.02			MDA	153.6		2.36			0.44			MDA	31.1		----		----	MDA	31.13	----	MDA	187	----
I-9	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	0.84			1.08			----		----	----	----	----	----	----	----
I-9	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.5			0.54			----		----	----	----	----	----	----	----
I-9	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.64			----		----	----	----	----	----	----	----
I-11	Nov-95	Filtered	----	----	----	0.43			MDA	141.1		0.9			MDA	0.78		MDA			MDA	25.62		MDA	25.46	----	MDA	190	----
I-11	Nov-95	unfiltered	----	----	----	MDA	0.2		MDA	149.6		0.36			1.18			MDA			MDA	30.59		MDA	31.9	----	MDA	213	----
I-11	Feb-96	Filtered	----	----	----	MDA	0.3		MDA	133.2		MDA	0.32		0.62			MDA			----		----	MDA	28.31	----	MDA	143	----

Table C-3 : Groundwater Analytical Results - Gross Alpha and Uranium-238 Decay Series

			Gross Alpha			Uranium-238			Thorium-234			Uranium-234			Thorium-230			Radium-226			Lead-214			Bismuth-214			Lead-210		
Monitoring Well	Date	Filtered	Result	+/- Sigma	MDA	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma
I-11	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	MDA	0.11		0.85			----		----	----	----	----	----	----	----
I-11	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.47			0.5			----		----	----	----	----	----	----	----
I-11	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.59			----		----	----	----	----	----	----	----
I-62	Nov-95	Filtered	----	----	----	MDA	0.44		MDA	57.19		0.71			1.43			MDA	17.1		MDA	14.5		MDA	17.06	----	MDA	114	----
I-62	Nov-95	unfiltered	----	----	----	0.4			MDA	42.7		0.39			1.16			MDA	14.2		MDA	12.16		MDA	14.17	----	MDA	58.7	----
I-62	Feb-96	Filtered	----	----	----	MDA	0.34		MDA	133.8		0.38			0.67			MDA	26.6		----		----	MDA	26.58	----	144		
I-62	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	1.63			0.37			----		----	----	----	----	----	----	----
I-62	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.43			MDA	0.14		----		----	----	----	----	----	----	----
I-62	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.35			----		----	----	----	----	----	----	----
I-65	Nov-95	Filtered	----	----	----	0.34			MDA	88.22		0.58			0.61			MDA	23.3		MDA	19.6		MDA	23.32	----	MDA	133	----
I-65	Nov-95	unfiltered	----	----	----	0.31			MDA	130.9		0.34			1.89			MDA	24.6		MDA	20.9		MDA	24.59	----	MDA	109	----
I-65	Feb-96	Filtered	----	----	----	0.36			MDA	150.9		0.46			0.59			MDA	41.5		----		----	MDA	41.48	----	MDA	205	----
I-65	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	MDA	0.2		0.79			----		----	----	----	----	----	----	----
I-65	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.67			MDA	0.44		----		----	----	----	----	----	----	----
I-65	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	MDA	0.15		----		----	----	----	----	----	----	----
I-66	Nov-95	Filtered	----	----	----	1.18			MDA	145.5		1.23			MDA	2.62		MDA	31.3		MDA	24.85		MDA	31.27	----	MDA	179	----
I-66	Nov-95	unfiltered	----	----	----	1.22			MDA	145.8		0.91			MDA	2.54		MDA	28.2		MDA	24.82		MDA	28.17	----	MDA	186	----
I-66	Feb-96	Filtered	----	----	----	0.89			MDA	163.2		1.1			0.66			MDA	33.6		----		----	MDA	33.63	----	MDA	161	----
I-66	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	0.97			0.57			----		----	----	----	----	----	----	----
I-66	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	1.09			MDA	0.34		----		----	----	----	----	----	----	----
I-66	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	MDA	0.18		----		----	----	----	----	----	----	----
I-66 DUP (F)	Nov-95	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
I-66 DUP (F)	Nov-95	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
I-66 DUP (F)	Feb-96	Filtered	----	----	----	3.09			MDA	137.6		14			0.56			MDA	35.5		----		----	MDA	35.51	----	MDA	142	----
I-66 DUP (F)	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	MDA	0.23		0.48			----		----	----	----	----	----	----	----
I-66 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
I-66 DUP (F)	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
I-67	Nov-95	Filtered	----	----	----	0.46			MDA	145.4		0.34			MDA	2.19		MDA	23.9		MDA	32.04		MDA	23.85	----	MDA	144	----
I-67	Nov-95	unfiltered	----	----	----	0.17			MDA	228.2		0.54			3.58			MDA	28.5		MDA	24.51		MDA	28.46	----	MDA	1300	----
I-67	Feb-96	Filtered	----	----	----	0.35			MDA	166.2		0.52			0.52			MDA	42		----		----	MDA	41.98	----	MDA	228	----
I-67	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	0.61			0.54			----		----	----	----	----	----	----	----
I-67	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.55			0.52			----		----	----	----	----	----	----	----
I-67	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.22			----		----	----	----	----	----	----	----
I-68	Nov-95	Filtered	----	----	----	1.48			MDA	143.6		1.24			MDA	1.04		MDA	28.6		MDA	22.39		MDA	28.61	----	MDA	177	----
I-68	Nov-95	unfiltered	----	----	----	0.84			MDA	107.9		1.6			MDA	0.7		MDA	27.7		MDA	24.57		101			MDA	199	----
I-68	Feb-96	Filtered	----	----	----	1.06			101			1.47			0.46			MDA	36.5		----		----	MDA	36.52	----	MDA	158	----
I-68	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	0.53			0.72			----		----	----	----	----	----	----	----
I-68	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.21			0.44			----		----	----	----	----	----	----	----
I-68	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.66			----		----	----	----	----	----	----	----
I-68 DUP (F)	Nov-95	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
I-68 DUP (F)	Nov-95	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
I-68 DUP (F)	Feb-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
I-68 DUP (F)	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
I-68 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.46			0.47			----		----	----	----	----	----	----	----
I-68 DUP (F)	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	0.6			----		----	----	----	----	----	----	----
Deep Depth Wells																													
D-3	Nov-95	Filtered	----	----	----	1.4			MDA	282.4		2.47			0.96			MDA	39.8		MDA	36.53		MDA	39.85	----	MDA	2940	----
D-3	Nov-95	unfiltered	----	----	----	2.5			MDA	65.68		3.39			MDA	0.58		MDA	28.1		MDA	20.4		MDA	28.07	----	MDA	101	----
D-3	Feb-96	Filtered	----	----	----	0.75			MDA	130.8		1.04			0.64			MDA	27.2		----		----	MDA	27.24	----	MDA	106	----
D-3	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	0.36			2.7			----		----	----	----	----	----	----	----
D-3	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.41			0.78			----		----	----	----	----	----	----	----
D-3	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1.19			----		----	----	----	----	----	----	----
D-3	May-97	Filtered	0.16			0.16			----	----	----	0.3			0.054			0.75			MDA	26.5		MDA	30.2	----	MDA	203	----
D-3	May-97	unfiltered	2.14			0.11			----	----	----	0.25			0.028			1.5			MDA	26.8		MDA	29.3	----	MDA	234	----
D-3 DUP (F)	Nov-95	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
D-3 DUP (F)	Nov-95	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
D-3 DUP (F)	Feb-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
D-3 DUP (F)	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
D-3 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.37			1.17			----		----	----	----	----	----	----	----
D-3 DUP (F)	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1.21			----		----	----	----	----	----	----	----
D-6	Nov-95	Filtered	----	----	----	0.73			MDA	149		1.61			0.99			MDA	28.6		MDA	25.69		MDA	28.65	----	MDA	186	----
D-6	Nov-95	unfiltered	----	----	----	0.54			MDA	140.7		1.69			0.61			MDA	28.2		MDA	24.51		MDA	28.25	----	MDA	149	----
D-6	Feb-96	Filtered	----	----	----	0.36			MDA	122.3		0.68			0.2			MDA	36.7		----		----	MDA	36.69	----	MDA	227	----
D-6	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	0.71			1.78			----		----	----	----	----	----	----	----
D-6	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	0.54			1.66			----		----	----	----	----	----	----	----
D-6	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	1.88			----		----	----	----	----	----	----	----
D-6	May-97	Filtered	1.54			0.063			----	----	----	0.13			0.13			1.8			MDA	27.2		MDA	27	----	204		
D-6	May-97	unfiltered	8.79			1.13			----	----	----	2.46			0.52			2.05			MDA	13.6		MDA	16.2		MDA	100	
D-12	Nov-95	Filtered	----	----	----	MDA	0.24		MDA	82.01		0.43			MDA	0.77		MDA	15.4		MDA	12.8		MDA	15.4	----	MDA	75.8	----
D-12	Nov-95	unfiltered	----	----	----	0.81			MDA	83.22		1.4			MDA	4.66		MDA	16.1		MDA	14.06		114			MDA	109	----

Table C-3 : Groundwater Analytical Results - Gross Alpha and Uranium-238 Decay Series

Monitoring Well	Date	Filtered	Gross Alpha			Uranium-238			Thorium-234			Uranium-234			Thorium-230			Radium-226			Lead-214			Bismuth-214			Lead-210		
			Result	+/- Sigma	MDA	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma
D-12	Feb-96	Filtered	----	----	----	MDA	0.117		**114**			**0.24**			**5.08**			MDA	44.7		----		----	MDA	44.67	----	MDA	166	----
D-12	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	**0.51**			**0.5**			----		----	----	----	----	----	----	----
D-12	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	**0.5**			**0.36**			----		----	----	----	----	----	----	----
D-12	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	**0.73**			----		----	----	----	----	----	----	----
D-12	May-97	Filtered	**1.15**			**0.23**			----	----	----	**0.22**			**0.14**			**0.49**			MDA	24		MDA	30.6	----	MDA	355	----
D-12	May-97	Filtered	-0.35		0.33	**0.02**			----	----	----	**0.23**			**0.16**			**0.26**			MDA	28.8		MDA	40.7	----	MDA	212	----
D-12	May-97	unfiltered	**2.27**			**0.14**			----	----	----	**0.23**			**0.2**			**0.54**			MDA	25	----	MDA	28.4	----	MDA	411	----
D-13	Nov-95	Filtered	----	----	----	MDA	0.19		MDA	126.3		**0.57**			MDA	2.15		MDA	23.9		MDA	21.67		MDA	23.89	----	MDA	135	----
D-13	Nov-95	unfiltered	----	----	----	MDA	1.3		MDA	99.67		**2.95**			**4.25**			MDA	30.2		MDA	25.78		MDA	30.25	----	MDA	194	----
D-13	Feb-96	Filtered	----	----	----	MDA	0.189		MDA	141.5		**0.44**			**0.29**			MDA	24.6		----		----	MDA	24.6	----	MDA	135	----
D-13	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	**0.64**			**1.33**			----		----	----	----	----	----	----	----
D-13	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	**0.27**			**0.58**			----		----	----	----	----	----	----	----
D-13	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	**0.86**			----		----	----	----	----	----	----	----
D-14	Nov-95	Filtered	----	----	----	**3.33**			MDA	139.1		**3.11**			MDA	2.23		MDA	31.3		**30.6**			MDA	31.33	----	MDA		----
D-14	Nov-95	unfiltered	----	----	----	**3.71**			MDA	143.2		**4.16**			**0.93**			**69.8**			**71**			**69.4**			MDA		----
D-14	Feb-96	Filtered	----	----	----	**0.52**			MDA	208.8		**0.57**			**0.24**			**96.7**			----		----	MDA	42.02	----	MDA	323	----
D-14	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	**1.14**			**1.5**			----		----	----	----	----	----	----	----
D-14	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
D-14	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
D-83	Nov-95	Filtered	----	----	----	**0.33**			MDA	53.81		**0.48**			**0.95**			MDA	14		MDA	10.82		MDA	13.96	----	MDA	81.3	----
D-83	Nov-95	unfiltered	----	----	----	**0.73**			MDA	204.6		**0.71**			**1.24**			MDA	25.8		MDA	23.92		MDA	25.75	----	MDA	2100	----
D-83	Feb-96	Filtered	----	----	----	MDA	0.21		MDA	116.1		MDA	0.2		**0.4**			MDA	30.5		----		----	MDA	30.46	----	MDA	222	----
D-83	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	**0.83**			**1.25**			----		----	----	----	----	----	----	----
D-83	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	MDA			**0.82**			----		----	----	----	----	----	----	----
D-83	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	**0.81**	----	----	----		----	----	----	----	----	----	----
D-85	Nov-95	Filtered	----	----	----	MDA	0.24		MDA	144.7		MDA	0.3		**4.66**			MDA	31.4		MDA	24.28		MDA	31.38	----	MDA	190	----
D-85	Nov-95	unfiltered	----	----	----	**0.21**			MDA	143.8		**0.76**			**1**			MDA	25.9		MDA	22.54		MDA	25.86	----	MDA	151	----
D-85	Feb-96	Filtered	----	----	----	**0.32**			MDA	357.7		**0.58**			**0.65**			MDA	54.4		----		----	MDA	54.4	----	MDA	3070	----
D-85	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	**0.92**			**0.58**			----		----	----	----	----	----	----	----
D-85	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	**0.7**			**0.54**			----		----	----	----	----	----	----	----
D-85	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	**0.16**			----		----	----	----	----	----	----	----
D-85 DUP (F)	Nov-95	Filtered	----	----	----	----	----	----	MDA	81.52		----	----	----	----	----	----	MDA	33.9		MDA	29.76		MDA	33.9	----	MDA	156	----
D-85 DUP (F)	Nov-95	unfiltered	----	----	----	----	----	----	MDA	122.1		----	----	----	----	----	----	MDA	27		MDA	22.88		MDA	27.02	----	MDA	146	----
D-85 DUP (F)	Feb-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
D-85 DUP (F)	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
D-85 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
D-85 DUP (F)	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
D-93	Nov-95	Filtered	----	----	----	**0.15**			MDA	148.1		**0.22**			**0.67**			MDA	28.6		MDA	21.8		MDA	28.62	----	MDA	176	----
D-93	Nov-95	unfiltered	----	----	----	MDA	0.35		MDA	77.99		MDA	0.47		**0.64**			MDA	26.5		MDA	23.01		MDA	26.54	----	MDA	189	----
D-93	Feb-96	Filtered	----	----	----	MDA	0.18		MDA	198.1		**0.42**			**0.25**			MDA	29.6		----		----	MDA	29.59	----	MDA	306	----
D-93	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	**0.53**			**1.43**			----		----	----	----	----	----	----	----
D-93	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	**0.47**			**0.95**			----		----	----	----	----	----	----	----
D-93	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	**2.09**			----		----	----	----	----	----	----	----
D-93	May-97	Filtered	MDA		0.17	**0.047**			----	----	----	**0.19**			**2.69**			**1.18**			MDA	23.3		MDA	30.9	----	MDA	190	----
D-93	May-97	unfiltered	**0.94**			**2.12**			----	----	----	**2.87**			**0.26**			**1.34**			MDA	14.3		MDA	16.2	----	MDA	108	----
D-93 DUP (F)	Nov-95	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----
D-93 DUP (F)	Feb-96	Filtered	----	----	----	MDA	0.13		MDA	324.8		**0.22**			**0.94**			MDA	46		----		----	MDA	46.01	----	MDA	4050	----
D-93 DUP (F)	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	**0.78**			**1.21**			----		----	----	----	----	----	----	----
D-93 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----		----	----	----	----	----	----	----

All values expressed as pCi/L, unless otherwise noted.
---- = not analyzed
MDA = Minimum Detectable Activity
Bold numbers indicate results above the MDA.
xx = No tracer counts. Therefore, results could not be generated.

Table C-4 : Groundwater Analytical Results - Uranium-235 Decay Series

Monitoring Well	Date	Filtered	U-235/236 Result	U-235/236 MDA	U-235/236 +/- Sigma	Uranium-235 Result	Uranium-235 MDA	Uranium-235 +/- Sigma
Shallow Depth Wells								
S-1	Nov-95	Filtered	**0.71**			<MDA	-43.9	—
S-1	Nov-95	unfiltered	**0.57**			<MDA	-56.75	—
S-1	Feb-96	Filtered				<MDA	-71.65	—
S-1	Feb-96	unfiltered	—	—	—	—	—	—
S-1	May-96	Filtered	—	—	—	—	—	—
S-1	May-96	unfiltered	—	—	—	—	—	—
S-1 DUP (F)	Nov-95	Filtered	—	—	—	—	—	—
S-1 DUP (F)	Nov-95	unfiltered	—	—	—	—	—	—
S-1 DUP (F)	Feb-96	Filtered				<MDA	-63.72	—
S-1 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—
S-1 DUP (F)	May-96	Filtered	<MDA	0.23	—	—	—	—
S-1 DUP (F)	May-96	unfiltered	—	—	—	—	—	—
S-5	Nov-95	Filtered	<MDA	0.39	—	<MDA	-59.82	—
S-5	Nov-95	unfiltered	<MDA	0.33	—	<MDA	-44.64	—
S-5	Feb-96	Filtered	—	—	—	<MDA	-118.4	—
S-5	Feb-96	unfiltered	—	—	—	—	—	—
S-5	May-96	Filtered	<MDA	0.18	—	—	—	—
S-5	May-96	unfiltered	—	—	—	—	—	—
S-8	Nov-95	Filtered	<MDA	0.46	—	<MDA	-60.68	—
S-8	Nov-95	unfiltered	<MDA	0.32	—	<MDA	-127.8	—
S-8	Feb-96	Filtered	**0.38**	0.38	—	<MDA	-39.49	—
S-8	Feb-96	unfiltered	—	—	—	—	—	—
S-8	May-96	Filtered	—	—	—	—	—	—
S-8	May-96	unfiltered	—	—	—	—	—	—
S-10	Nov-95	Filtered	<MDA	0.56	—	<MDA	-60.23	—
S-10	Nov-95	unfiltered	**1.18**			<MDA	-53.93	—
S-10	Feb-96	Filtered	—	—	—	<MDA	-55.66	—
S-10	Feb-96	unfiltered	—	—	—	—	—	—
S-10	May-96	Filtered	—	—	—	—	—	—
S-10	May-96	unfiltered	—	—	—	—	—	—
S-61	Nov-95	Filtered	**0.33**			<MDA	-49.81	—
S-61	Nov-95	unfiltered	**0.31**			<MDA	-50.15	—
S-61	Feb-96	Filtered	<MDA	-0.191	—	<MDA	-73.64	—
S-61	Feb-96	unfiltered	—	—	—	—	—	—
S-61	May-96	Filtered	—	—	—	—	—	—
S-61	May-96	unfiltered	—	—	—	—	—	—
S-80	Nov-95	Filtered	**0.4**			<MDA	-48.8	—
S-80	Nov-95	unfiltered	**0.28**			<MDA	-60.62	—
S-80	Feb-96	Filtered	<MDA	-0.206	—	<MDA	-49.66	—
S-80	Feb-96	unfiltered	—	—	—	—	—	—
S-80	May-96	Filtered	—	—	—	—	—	—
S-80	May-96	unfiltered	—	—	—	—	—	—
S-80 DUP (F)	Nov-95	Filtered	—	—	—	—	—	—
S-80 DUP (F)	Nov-95	unfiltered	—	—	—	—	—	—
S-80 DUP (F)	Feb-96	Filtered	<MDA	-0.33	—	<MDA	-87.47	—
S-80 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—
S-80 DUP (F)	May-96	Filtered	—	—	—	—	—	—
S-80 DUP (F)	May-96	unfiltered	—	—	—	—	—	—
S-82	Nov-95	Filtered	**0.43**			<MDA	-23.51	—
S-82	Nov-95	unfiltered	**0.82**			<MDA	-40.38	—
S-82	Feb-96	Filtered	**0.37**			<MDA	-106.3	—
S-82	Feb-96	unfiltered	—	—	—	—	—	—
S-82	May-96	Filtered	—	—	—	—	—	—
S-82	May-96	unfiltered	—	—	—	—	—	—
S-82	May-97	Filtered	**0.1**	0.028	0.07	—	—	—
S-82	May-97	unfiltered	**0.18**	0.25	0.18	—	—	—
S-82	May-97	unfiltered	**0.12**	0.24	0.15	—	—	—
S-84	Nov-95	Filtered	<MDA	-0.165	—	<MDA	-40.25	—
S-84	Nov-95	unfiltered	<MDA	-0.334	—	<MDA	-57	—
S-84	Feb-96	Filtered	**0.28**			<MDA	-64.21	—
S-84	Feb-96	unfiltered	—	—	—	—	—	—
S-84	May-96	Filtered	—	—	—	—	—	—
S-84	May-96	unfiltered	—	—	—	—	—	—
S-84 DUP (F)	Nov-95	Filtered	—	—	—	<MDA	-68.47	—
S-84 DUP (F)	Nov-95	unfiltered	—	—	—	<MDA	-49	—
S-84 DUP (F)	Feb-96	Filtered	—	—	—	—	—	—
S-84 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—
S-84 DUP (F)	May-96	Filtered	—	—	—	—	—	—

Monitoring Well	Date	Filtered	Protactinium-231 Result	Protactinium-231 MDA	Protactinium-231 +/- Sigma	Actinium-227 Result	Actinium-227 MDA	Actinium-227 +/- Sigma	Radium-223 Result	Radium-223 MDA	Radium-223 +/- Sigma
Shallow Depth Wells											
S-1	Nov-95	Filtered	<MDA	-242	—	<MDA	-47	—	<MDA	-567.1	—
S-1	Nov-95	unfiltered	<MDA	-289	—	<MDA	-58.4	—	<MDA	-683.2	—
S-1	Feb-96	Filtered	<MDA	-312	—	<MDA	-66.4	—	<MDA	-759.5	—
S-1	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—
S-1	May-96	Filtered	—	—	—	—	—	—	—	—	—
S-1	May-96	unfiltered	—	—	—	—	—	—	—	—	—
S-1 DUP (F)	Nov-95	Filtered	—	—	—	—	—	—	—	—	—
S-1 DUP (F)	Nov-95	unfiltered	—	—	—	—	—	—	—	—	—
S-1 DUP (F)	Feb-96	Filtered	<MDA	-543	—	<MDA	-54.1	—	<MDA	-706	—
S-1 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—
S-1 DUP (F)	May-96	Filtered	—	—	—	—	—	—	—	—	—
S-1 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—
S-5	Nov-95	Filtered	<MDA	-313	—	<MDA	-64.2	—	<MDA	-350.1	—
S-5	Nov-95	unfiltered	<MDA	-284	—	<MDA	-50	—	<MDA	-269.8	—
S-5	Feb-96	Filtered	<MDA	-287	—	<MDA	-110	—	<MDA	-479.7	—
S-5	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—
S-5	May-96	Filtered	—	—	—	—	—	—	—	—	—
S-5	May-96	unfiltered	—	—	—	—	—	—	—	—	—
S-8	Nov-95	Filtered	<MDA	-364	—	<MDA	-65.4	—	<MDA	-324.8	—
S-8	Nov-95	unfiltered	<MDA	-563	—	<MDA	-118	—	<MDA	-561.5	—
S-8	Feb-96	Filtered	<MDA	-333	—	<MDA	-50.6	—	<MDA	-770.33	—
S-8	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—
S-8	May-96	Filtered	—	—	—	—	—	—	—	—	—
S-8	May-96	unfiltered	—	—	—	<MDA	—	—	—	—	—
S-10	Nov-95	Filtered	<MDA	-379	—	<MDA	-64.4	—	<MDA	-300.7	—
S-10	Nov-95	unfiltered	<MDA	-353	—	<MDA	-62.3	—	<MDA	-321.6	—
S-10	Feb-96	Filtered	<MDA	-326	—	<MDA	-58.6	—	<MDA	-378.8	—
S-10	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—
S-10	May-96	Filtered	—	—	—	—	—	—	—	—	—
S-10	May-96	unfiltered	—	—	—	—	—	—	—	—	—
S-61	Nov-95	Filtered	<MDA	-286	—	<MDA	-55.8	—	<MDA	-489.9	—
S-61	Nov-95	unfiltered	<MDA	-337	—	<MDA	-58.4	—	<MDA	-514.1	—
S-61	Feb-96	Filtered	<MDA	-258	—	<MDA	-63	—	<MDA	-350.6	—
S-61	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—
S-61	May-96	Filtered	—	—	—	—	—	—	—	—	—
S-61	May-96	unfiltered	—	—	—	—	—	—	—	—	—
S-80	Nov-95	Filtered	<MDA	-349	—	<MDA	-53.5	—	<MDA	-453.1	—
S-80	Nov-95	unfiltered	<MDA	-333	—	<MDA	-65.9	—	<MDA	-449.1	—
S-80	Feb-96	Filtered	<MDA	-420	—	<MDA	-54.6	—	<MDA	-320.2	—
S-80	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—
S-80	May-96	Filtered	—	—	—	—	—	—	—	—	—
S-80	May-96	unfiltered	—	—	—	—	—	—	—	—	—
S-80 DUP (F)	Nov-95	Filtered	—	—	—	—	—	—	—	—	—
S-80 DUP (F)	Nov-95	unfiltered	—	—	—	—	—	—	—	—	—
S-80 DUP (F)	Feb-96	Filtered	<MDA	-482	—	<MDA	-82.6	—	<MDA	-944.6	—
S-80 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—
S-80 DUP (F)	May-96	Filtered	—	—	—	—	—	—	—	—	—
S-80 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—
S-82	Nov-95	Filtered	<MDA	-136	—	<MDA	-25.1	—	<MDA	-306.7	—
S-82	Nov-95	unfiltered	<MDA	-255	—	<MDA	-45.8	—	<MDA	-556.7	—
S-82	Feb-96	Filtered	<MDA	-282	—	<MDA	-94.7	—	<MDA	-515.3	—
S-82	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—
S-82	May-96	Filtered	—	—	—	—	—	—	—	—	—
S-82	May-96	unfiltered	—	—	—	—	—	—	—	—	—
S-82	May-97	Filtered	<MDA	-390	—	<MDA	-72.8	—	<MDA	-232	—
S-82	May-97	unfiltered	<MDA	-344	—	<MDA	-56.1	—	<MDA	-120	—
S-82	May-97	unfiltered	<MDA	-382	—	<MDA	-71.1	—	<MDA	-172	—
S-84	Nov-95	Filtered	<MDA	-260	—	<MDA	-46.7	—	<MDA	-544.4	—
S-84	Nov-95	unfiltered	<MDA	-341	—	<MDA	-63.8	—	<MDA	-664.8	—
S-84	Feb-96	Filtered	—	—	—	<MDA	-61.3	—	<MDA	-348.4	—
S-84	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—
S-84	May-96	Filtered	—	—	—	—	—	—	—	—	—
S-84	May-96	unfiltered	—	—	—	—	—	—	—	—	—
S-84 DUP (F)	Nov-95	Filtered	<MDA	-314	—	<MDA	-71	—	<MDA	-768.3	—
S-84 DUP (F)	Nov-95	unfiltered	<MDA	-338	—	<MDA	-57.9	—	<MDA	-752.6	—
S-84 DUP (F)	Feb-96	Filtered	<MDA	-256	—	—	—	—	—	—	—
S-84 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—
S-84 DUP (F)	May-96	Filtered	—	—	—	—	—	—	—	—	—

Table C-4 : Groundwater Analytical Results - Uranium-235 Decay Series

Monitoring Well	Date	Filtered	U-235/236			Uranium-235			Protactinium-231			Actinium-227			Radium-223		
			Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma
S-84 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-101	Nov-95	Filtered	<MDA	-1.63	—	<MDA	-43.25	—	<MDA	-242	—	<MDA	-47.6	—	<MDA	-428	—
MW-101	Nov-95	unfiltered	**0.56**			<MDA	-42.47	—	<MDA	-270	—	<MDA	-46.6	—	<MDA	-376.9	—
MW-101	Feb-96	Filtered	<MDA	-0.24	—	<MDA	-46.5	—	<MDA	-385	—	<MDA	-51.1	—	<MDA	-619.9	—
MW-101	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-101	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-101	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107	Nov-95	Filtered	**0.5**			<MDA	-38.12	—	<MDA	-160	—	<MDA	-34.3	—	<MDA	-207.1	—
MW-107	Nov-95	unfiltered	<MDA	-1.2	—	<MDA	-40.43	—	<MDA	-184	—	<MDA	-39.6	—	<MDA	-237.2	—
MW-107	Feb-96	Filtered	<MDA	-0.48	—	<MDA	-67.86	—	—	—	—	<MDA	-69.2	—	<MDA	-438.1	—
MW-107	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107 DUP (F)	Nov-95	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107 DUP (F)	Nov-95	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107 DUP (F)	Feb-96	Filtered	—	—	—	—	—	—	<MDA	-308	—	—	—	—	—	—	—
MW-107 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107 DUP (F)	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-F3	Nov-95	Filtered	<MDA	-0.35	—	<MDA	-60.71	—	<MDA	-294	—	<MDA	-60.2	—	<MDA	-439.1	—
MW-F3	Nov-95	unfiltered	<MDA	-0.56	—	<MDA	-128.2	—	<MDA	-602	—	<MDA	-125	—	<MDA	-933.4	—
MW-F3	Feb-96	Filtered	<MDA	-0.21	—	<MDA	-75.09	—	<MDA	-336	—	<MDA	-72.8	—	<MDA	-380.3	—
MW-F3	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-F3	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-F3	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PZ-114-AS	Nov-95	Filtered	**0.14**			<MDA	-41.51	—	<MDA	-248	—	<MDA	-42.2	—	<MDA	-523.4	—
PZ-114-AS	Nov-95	unfiltered	<MDA	0.153	—	<MDA	-40.77	—	<MDA	-233	—	<MDA	-41.9	—	<MDA	-566	—
PZ-114-AS	Feb-96	Filtered	<MDA	0.163	—	<MDA	-52.37	—	<MDA	-391	—	<MDA	-67	—	<MDA	-372.8	—
PZ-114-AS	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PZ-114-AS	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PZ-114-AS	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Intermediate Depth Wells								—			—			—			—
I-2	Nov-95	Filtered	**0.91**			<MDA	-34.44	—	<MDA	-161	—	<MDA	-31.2	—	<MDA	-341.3	—
I-2	Nov-95	unfiltered	<MDA	0.48	—	<MDA	-34.97	—	<MDA	-166	—	<MDA	-36	—	<MDA	-374.1	—
I-2	Feb-96	Filtered	—	—	—	<MDA	-55.37	—	<MDA	-368	—	<MDA	-59.7	—	<MDA	-379.2	—
I-2	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-2	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-2	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-2	May-97	Filtered	<MDA	0.004	—	—	—	—	<MDA	-351	—	<MDA	-78.3	—	<MDA	-156	—
I-2	May-97	unfiltered	**0.049**	0.14	0.078	—	—	—	<MDA	-404	—	<MDA	-69.6	—	<MDA	-170	—
I-2-DUP	May-97	Filtered	**0.029**	0.15	0.07	—	—	—	<MDA	-399	—	<MDA	-84.3	—	<MDA	-479	—
I-2-DUP	May-97	unfiltered	**0.08**	0.17	0.11	—	—	—	<MDA	-433	—	<MDA	-83.8	—	<MDA	-524	—
I-4	Nov-95	Filtered	<MDA	-0.283	—	<MDA	-116.7	—	<MDA	-536	—	<MDA	-108	—	<MDA	-113.9	—
I-4	Nov-95	unfiltered	<MDA	-0.167	—	<MDA	-41.66	—	<MDA	-251	—	<MDA	-48.3	—	<MDA	-538.1	—
I-4	Feb-96	Filtered	<MDA	-0.48	—	<MDA	-61.32	—	—	—	—	<MDA	-69.1	—	<MDA	-305.9	—
I-4	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-4	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-4	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-4	May-97	Filtered	**0.019**	0.065	0.035	—	—	—	<MDA	-315	—	<MDA	-50.8	—	<MDA	-122	—
I-4	May-97	unfiltered	**0.017**	0.12	0.052	—	—	—	<MDA	-456	—	<MDA	-82.3	—	<MDA	-466	—
I-4 DUP (F)	Nov-95	Filtered	—	—	—	<MDA	-60.6	—	<MDA	-327	—	<MDA	-68	—	<MDA	-737.5	—
I-4 DUP (F)	Nov-95	unfiltered	—	—	—	**56.48**			<MDA	-290	—	<MDA	-53.6	—	<MDA	-701.8	—
I-4 DUP (F)	Feb-96	Filtered	<MDA	0.25	—	—	—	—	<MDA	-520	—	—	—	—	—	—	—
I-4 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-4 DUP (F)	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-4 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-7	Nov-95	Filtered	<MDA	-0.47	—	<MDA	-66.03	—	<MDA	-290	—	<MDA	-61.4	—	<MDA	-436.4	—
I-7	Nov-95	unfiltered	**0.75**			<MDA	-119.8	—	<MDA	-546	—	<MDA	-113	—	<MDA	-840.8	—
I-7	Feb-96	Filtered	<MDA	-0.26	—	<MDA	-120.2	—	<MDA	-310	—	<MDA	-110	—	<MDA	-139.2	—
I-7	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-7	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-7	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-9	Nov-95	Filtered	**0.85**			<MDA	-22.35	—	<MDA	-133	—	<MDA	-28.3	—	<MDA	-296.1	—
I-9	Nov-95	unfiltered	**0.33**			<MDA	-75.67	—	<MDA	-335	—	<MDA	-67	—	<MDA	-692.4	—
I-9	Feb-96	Filtered	<MDA	-0.062	—	<MDA	-53.89	—	<MDA	-262	—	<MDA	-56.3	—	<MDA	-371	—
I-9	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-9	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-9	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-11	Nov-95	Filtered	<MDA	-0.25	—	<MDA	-30.7	—	<MDA	-289	—	<MDA	-61.2	—	<MDA	-397.9	—

Table C-4 : Groundwater Analytical Results - Uranium-235 Decay Series

Monitoring Well	Date	Filtered	U-235/236 Result	U-235/236 MDA	U-235/236 +/- Sigma	Uranium-235 Result	Uranium-235 MDA	Uranium-235 +/- Sigma	Protactinium-231 Result	Protactinium-231 MDA	Protactinium-231 +/- Sigma	Actinium-227 Result	Actinium-227 MDA	Actinium-227 +/- Sigma	Radium-223 Result	Radium-223 MDA	Radium-223 +/- Sigma
I-11	Nov-95	unfiltered	**0.39**			<MDA	-56.7	----	<MDA	-298	----	<MDA	-69.3	----	<MDA	-442	----
I-11	Feb-96	Filtered	----	----	----	<MDA	-45.84	----	<MDA	-244	----	<MDA	-40.4	----	<MDA	-278.7	----
I-11	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-11	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-11	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-62	Nov-95	Filtered	<MDA	-0.64	----	<MDA	-32	----	<MDA	-186	----	<MDA	-35.9	----	<MDA	-243.8	----
I-62	Nov-95	unfiltered	<MDA	-0.47	----	<MDA	-20.34	----	<MDA	-142	----	<MDA	-24.6	----	<MDA	-187.2	----
I-62	Feb-96	Filtered	<MDA			<MDA	-42.74	----	<MDA	-326	----	<MDA	-45.1	----	<MDA	-290.6	----
I-62	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-62	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-62	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-65	Nov-95	Filtered	<MDA	-0.16	----	<MDA	-39.84	----	<MDA	-241	----	<MDA	-47.7	----	<MDA	-464.8	----
I-65	Nov-95	unfiltered	<MDA	-0.35	----	<MDA	-44.52	----	<MDA	-232	----	<MDA	-42.2	----	<MDA	-488.7	----
I-65	Feb-96	Filtered	**0.24**			<MDA	-51.03	----	<MDA	-337	----	<MDA	-62.8	----	<MDA	-326.2	----
I-65	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-65	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-65	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-66	Nov-95	Filtered	**0.1**			<MDA	-53.46	----	<MDA	-326	----	<MDA	-62.4	----	<MDA	-615.5	----
I-66	Nov-95	unfiltered	**0.57**			<MDA	-52.99	----	<MDA	-281	----	<MDA	-56.1	----	<MDA	-556.9	----
I-66	Feb-96	Filtered	<MDA	-0.37	----	<MDA	-58.84	----	<MDA	-261	----	<MDA	-59.5	----	<MDA	-275	----
I-66	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-66	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-66	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-66 DUP (F)	Nov-95	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-66 DUP (F)	Nov-95	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-66 DUP (F)	Feb-96	Filtered	<MDA	-0.381	----	<MDA	-47.09	----	<MDA	-319	----	<MDA	-48.1	----	<MDA	-270.8	----
I-66 DUP (F)	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-66 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-66 DUP (F)	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-67	Nov-95	Filtered	<MDA	-0.245	----	<MDA	-50.13	----	<MDA	-276	----	<MDA	-54	----	<MDA	-526.8	----
I-67	Nov-95	unfiltered	<MDA	-0.207	----	<MDA	-66.19	----	<MDA	-303	----	<MDA	-68.6	----	<MDA	-636.9	----
I-67	Feb-96	Filtered	**0.053**			<MDA	-60.54	----	<MDA	-344	----	<MDA	-68.7	----	<MDA	-378.8	----
I-67	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-67	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-67	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-68	Nov-95	Filtered	<MDA	-0.159	----	<MDA	-54.69	----	<MDA	-292	----	<MDA	-55.4	----	<MDA	-725.1	----
I-68	Nov-95	unfiltered	<MDA	-0.22	----	<MDA	-56.01	----	<MDA	-314	----	<MDA	-62.1	----	<MDA	-776.8	----
I-68	Feb-96	Filtered	**0.06**			<MDA	-59.32	----	----	----	----	<MDA	-60.8	----	<MDA	-346.2	----
I-68	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-68	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-68	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-68 DUP (F)	Nov-95	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-68 DUP (F)	Nov-95	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-68 DUP (F)	Feb-96	Filtered	**1.67**			----	----	----	<MDA	-252	----	----	----	----	----	----	----
I-68 DUP (F)	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-68 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
I-68 DUP (F)	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Deep Depth Wells								----			----			----			----
D-3	Nov-95	Filtered	<MDA	-0.21	----	<MDA	-105.8	----	<MDA	-490	----	<MDA	-99.6	----	<MDA	-112	----
D-3	Nov-95	unfiltered	<MDA	-0.18	----	<MDA	-40.8	----	<MDA	-234	----	<MDA	-44.4	----	<MDA	-610.2	----
D-3	Feb-96	Filtered	**0.08**			<MDA	-44.72	----	----	----	----	<MDA	-43.6	----	<MDA	-221.4	----
D-3	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-3	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-3	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-3	May-97	Filtered	**0.047**			----	----	----	<MDA	-381	----	<MDA	-56.3	----	<MDA	-135	----
D-3	May-97	unfiltered	**0.087**			----	----	----	<MDA	-340	----	<MDA	-60	----	<MDA	-135	----
D-3 DUP (F)	Nov-95	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-3 DUP (F)	Nov-95	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-3 DUP (F)	Feb-96	Filtered	<MDA	-0.147	----	----	----	----	<MDA	-359	----	----	----	----	----	----	----
D-3 DUP (F)	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-3 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-3 DUP (F)	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-6	Nov-95	Filtered	**0.29**			<MDA	-57.74	----	<MDA	-320	----	<MDA	-59.5	----	<MDA	-516.1	----
D-6	Nov-95	unfiltered	<MDA	-0.46	----	<MDA	-52.59	----	<MDA	-282	----	<MDA	-53.7	----	<MDA	-456.2	----
D-6	Feb-96	Filtered	----	----	----	<MDA	-62.31	----	<MDA	-324	----	<MDA	-78.6	----	<MDA	-968.3	----
D-6	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-6	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-6	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-6	May-97	Filtered	**0.049**			----	----	----	<MDA	-358	----	<MDA	-68.3	----	<MDA	127	----

Table C-4 : Groundwater Analytical Results - Uranium-235 Decay Series

Monitoring Well	Date	Filtered	U-235/236			Uranium-235			Protactinium-231			Actinium-227			Radium-223		
			Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma
D-6	May-97	unfiltered	**0.67**			----	----	----	<MDA	-185	----	<MDA	-32.4	----	<MDA	-68.9	----
D-12	Nov-95	Filtered	<MDA	-0.3	----	<MDA	-28.2	----	<MDA	-164	----	<MDA	-31.2	----	<MDA	-210.9	----
D-12	Nov-95	unfiltered	<MDA	-0.33	----	<MDA	-20.07	----	<MDA	-176	----	<MDA	-31.2	----	<MDA	-230.1	----
D-12	Feb-96	Filtered	<MDA	-0.107	----	<MDA	-59.37	----	<MDA	-294	----	<MDA	-64.3	----	<MDA	-384.6	----
D-12	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-12	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-12	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-12	May-97	Filtered	**0.08**			----	----	----	<MDA	-317	----	<MDA	-67.9	----	<MDA	-225	----
D-12	May-97	Filtered	**0.1**			----	----	----	<MDA	-338	----	<MDA	-62.8	----	<MDA	-186	----
D-12	May-97	unfiltered	**0.003**			----	----	----	<MDA	-345	----	<MDA	-77.8	----	<MDA	-246	----
D-13	Nov-95	Filtered	<MDA	-0.24	----	<MDA	-42.82	----	<MDA	-270	----	<MDA	-45.5	----	<MDA	-358.6	----
D-13	Nov-95	unfiltered	<MDA	-1.51	----	<MDA	-58.25	----	<MDA	-324	----	<MDA	-60.9	----	<MDA	-483.2	----
D-13	Feb-96	Filtered	----	----	----	<MDA	-56.08	----	<MDA	-315	----	<MDA	-58.6	----	<MDA	-317.9	----
D-13	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-13	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-13	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-14	Nov-95	Filtered	**0.2**			<MDA	-47.86	----	<MDA	-309	----	<MDA	-53.4	----	<MDA	-265.7	----
D-14	Nov-95	unfiltered	**0.88**			<MDA	-65.63	----	<MDA	-332	----	<MDA	-65.5	----	<MDA	-282.8	----
D-14	Feb-96	Filtered	<MDA	-0.26	----	<MDA	-71.79	----	<MDA	-343	----	<MDA	-65.6	----	<MDA	-271	----
D-14	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-14	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-14	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-83	Nov-95	Filtered	<MDA	-0.31	----	<MDA	-22.81	----	<MDA	-134	----	<MDA	-25.2	----	<MDA	-197.2	----
D-83	Nov-95	unfiltered	<MDA	-0.49	----	<MDA	-73.92	----	<MDA	-341	----	<MDA	-40.3	----	<MDA	-468.6	----
D-83	Feb-96	Filtered	<MDA	-0.18	----	<MDA	-58.4	----	<MDA	-616	----	<MDA	-63.5	----	<MDA	-397.1	----
D-83	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-83	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-83	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-85	Nov-95	Filtered	<MDA	-0.39	----	<MDA	-57.02	----	<MDA	-326	----	<MDA	-65.4	----	<MDA	-776	----
D-85	Nov-95	unfiltered	**0.39**			<MDA	-50.08	----	<MDA	-316	----	<MDA	-57.2	----	<MDA	-626.9	----
D-85	Feb-96	Filtered	<MDA	-0.22	----	<MDA	-132.8	----	----	----	----	<MDA	-121	----	<MDA	-676.8	----
D-85	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	<MDA	----	----	----	----	----
D-85	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-85	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-85 DUP (F)	Nov-95	Filtered	----	----	----	<MDA	-50.48	----	<MDA	-305	----	<MDA	-56.7	----	<MDA	-635.9	----
D-85 DUP (F)	Nov-95	unfiltered	----	----	----	<MDA	-43.45	----	<MDA	-260	----	<MDA	-42.2	----	<MDA	-586	----
D-85 DUP (F)	Feb-96	Filtered	----	----	----	----	----	----	<MDA	-306	----	----	----	----	----	----	----
D-85 DUP (F)	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-85 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-85 DUP (F)	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-93	Nov-95	Filtered	<MDA	-0.14	----	<MDA	-55.04	----	<MDA	-310	----	<MDA	-56.8	----	<MDA	-595.2	----
D-93	Nov-95	unfiltered	<MDA	-0.4	----	<MDA	-50.15	----	<MDA	-315	----	<MDA	-52.3	----	<MDA	-657.8	----
D-93	Feb-96	Filtered	<MDA	-0.3	----	<MDA	-66.79	----	<MDA	-532	----	<MDA	-61.4	----	<MDA	-317.2	----
D-93	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-93	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-93	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-93	May-97	Filtered	**0.041**			----	----	----	<MDA	-297	----	<MDA	-60.3	----	<MDA	-134	----
D-93	May-97	unfiltered	**1.15**			----	----	----	<MDA	-164	----	<MDA	-33.5	----	<MDA	-72	----
D-93 DUP (F)	Nov-95	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-93 DUP (F)	Feb-96	Filtered	<MDA	-0.46	----	<MDA	-11.78	----	----	----	----	<MDA	-105	----	<MDA	-681.9	----
D-93 DUP (F)	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-93 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

All values expressed as pCi/L, unless otherwise noted.
---- = not analyzed
MDA = Minimum Detectable Activity
Bold numbers indicate results above the MDA.
xx = No tracer counts. Therefore, results could not be generated.

Table C-5 : Groundwater Analytical Results - Thorium-232 Decay Series

Monitoring Well	Date	Filtered	Thorium-232			Radium-228			Thorium-228			Radium-224			Lead-212			Bismuth-212			Thallium-208		
			Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma
Shallow Depth Wells																							
S-1	Nov-95	Filtered	<MDA	-0.31	---	<MDA	-41.81	---	6.21			<MDA	-153	---	<MDA	-152.1	---	<MDA	-76.55	---	<MDA	-10.83	---
S-1	Nov-95	unfiltered	<MDA	-0.47	---	<MDA	-50.89	---	5.98			---	---	---	<MDA	-16.41	---	<MDA	-100.1	---	<MDA	-12.34	---
S-1	Feb-96	Filtered	<MDA	-0.11	---	<MDA	-38.1	---	<MDA	-0.14	---	<MDA	-219.4	---	<MDA	-18.58	---	<MDA	-83.36	---	<MDA	-12.41	---
S-1	Feb-96	unfiltered	0.3			---	---	---	<MDA	-0.18	---	---	---	---	---	---	---	---	---	---	---	---	---
S-1	May-96	Filtered	<MDA	-0.08	---	---	---	---	<MDA	-0.14	---	---	---	---	---	---	---	---	---	---	---	---	---
S-1	May-96	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-1 DUP (F)	Nov-95	Filtered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-1 DUP (F)	Nov-95	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-1 DUP (F)	Feb-96	Filtered	---	---	---	<MDA	-41.44	---	---	---	---	<MDA	-150.5	---	<MDA	-17.58	---	<MDA	-74.3	---	9.8		
S-1 DUP (F)	Feb-96	unfiltered	0.14			---	---	---	0.27			---	---	---	---	---	---	---	---	---	---	---	---
S-1 DUP (F)	May-96	Filtered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-1 DUP (F)	May-96	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-5	Nov-95	Filtered	<MDA	-1.58	---	<MDA	-47.04	---	<MDA	-1.26	---	<MDA	-207.8	---	<MDA	-18.47	---	<MDA	-112.4	---	<MDA	-14.27	---
S-5	Nov-95	unfiltered	---	---	---	<MDA	-45.58	---	---	---	---	---	---	---	<MDA	-16.97	---	<MDA	-86.38	---	<MDA	-12.4	---
S-5	Feb-96	Filtered	<MDA	-0.25	---	<MDA	-75.33	---	<MDA	-0.188	---	<MDA	-321.5	---	<MDA	-28.69	---	<MDA	-147	---	<MDA	-20.07	---
S-5	Feb-96	unfiltered	<MDA	-0.24	---	---	---	---	<MDA	-0.29	---	---	---	---	---	---	---	---	---	---	---	---	---
S-5	May-96	Filtered	<MDA	-0.1	---	---	---	---	<MDA	-0.12	---	---	---	---	---	---	---	---	---	---	---	---	---
S-5	May-96	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-8	Nov-95	Filtered	---	---	---	<MDA	-54.23	---	---	---	---	<MDA	-237.8	---	<MDA	-20.41	---	<MDA	-117.2	---	<MDA	-15	---
S-8	Nov-95	unfiltered	<MDA	-0.27	---	<MDA	-62.41	---	<MDA	-0.49	---	---	---	---	<MDA	-30.49	---	<MDA	-15.26	---	<MDA	-23.67	---
S-8	Feb-96	Filtered	<MDA	-0.21	---	<MDA	-44.55	---	<MDA	-0.17	---	<MDA	-180.4	---	<MDA	-17.79	---	<MDA	-84.4	---	<MDA	-11.8	---
S-8	Feb-96	unfiltered	0.5			---	---	---	0.55			---	---	---	---	---	---	---	---	---	---	---	---
S-8	May-96	Filtered	<MDA	-0.07	---	---	---	---	<MDA	-0.11	---	---	---	---	---	---	---	---	---	---	---	---	---
S-8	May-96	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-10	Nov-95	Filtered	<MDA	-3.94	---	<MDA	-56	---	<MDA	-5.27	---	<MDA	-214.3	---	<MDA	-17.81	---	<MDA	-98.82	---	<MDA	-15.15	---
S-10	Nov-95	unfiltered	<MDA	-2.91	---	<MDA	-62.07	---	<MDA	-4.68	---	---	---	---	<MDA	-18.59	---	<MDA	-106.9	---	<MDA	-11.91	---
S-10	Feb-96	Filtered	<MDA	-0.1	---	<MDA	-57.55	---	<MDA	-0.14	---	<MDA	-203	---	<MDA	-17.54	---	<MDA	-98.77	---	<MDA	-13.84	---
S-10	Feb-96	unfiltered	<MDA	-10.2	---	---	---	---	<MDA	-10.2	---	---	---	---	---	---	---	---	---	---	---	---	---
S-10	May-96	Filtered	<MDA	-0.2	---	---	---	---	<MDA	-0.15	---	---	---	---	---	---	---	---	---	---	---	---	---
S-10	May-96	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-61	Nov-95	Filtered	<MDA	-0.41	---	<MDA	-43.27	---	<MDA	-0.34	---	<MDA	-194.9	---	<MDA	-17.31	---	<MDA	-88.83	---	<MDA	-10.84	---
S-61	Nov-95	unfiltered	<MDA	-0.31	---	<MDA	-58.86	---	<MDA	-0.34	---	---	---	---	<MDA	-18.72	---	<MDA	-95.6	---	<MDA	-11.26	---
S-61	Feb-96	Filtered	<MDA	-0.16	---	<MDA	-47.31	---	<MDA	-0.24	---	<MDA	-198.6	---	<MDA	-17.19	---	<MDA	-88.8	---	<MDA	-12.99	---
S-61	Feb-96	unfiltered	<MDA	-0.15	---	---	---	---	<MDA	-0.19	---	---	---	---	---	---	---	---	---	---	---	---	---
S-61	May-96	Filtered	0.06			---	---	---	<MDA	-0.18	---	---	---	---	---	---	---	---	---	---	---	---	---
S-61	May-96	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-80	Nov-95	Filtered	<MDA	-0.38	---	<MDA	-46.59	---	<MDA	-0.61	---	<MDA	-197.4	---	<MDA	-17.87	---	<MDA	-89.79	---	<MDA	-13.78	---
S-80	Nov-95	unfiltered	<MDA	-1.35	---	<MDA	-45.1	---	<MDA	-1.65	---	---	---	---	<MDA	-18.89	---	<MDA	-96.42	---	<MDA	-14.76	---
S-80	Feb-96	Filtered	<MDA	-0.11	---	<MDA	-46.43	---	<MDA	-0.097	---	<MDA	-204.7	---	<MDA	-13.85	---	<MDA	-92.29	---	<MDA	-12.61	---
S-80	Feb-96	unfiltered	3.73			---	---	---	4.06			---	---	---	---	---	---	---	---	---	---	---	---
S-80	May-96	Filtered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-80	May-96	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-80 DUP (F)	Nov-95	Filtered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-80 DUP (F)	Nov-95	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-80 DUP (F)	Feb-96	Filtered	---	---	---	<MDA	-63.1	---	---	---	---	<MDA	-275	---	<MDA	-25.97	---	<MDA	-112.5	---	<MDA	-13.76	---
S-80 DUP (F)	Feb-96	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-80 DUP (F)	May-96	Filtered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-80 DUP (F)	May-96	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-82	Nov-95	Filtered	<MDA	-0.62	---	<MDA	-22.42	---	8.98			<MDA	-73.13	---	<MDA	-9	---	<MDA	-40.27	---	<MDA	-6.53	---
S-82	Nov-95	unfiltered	<MDA	-1.1	---	<MDA	-46.16	---	7.99			---	---	---	<MDA	-14.71	---	<MDA	-88.62	---	<MDA	-10.54	---
S-82	Feb-96	Filtered	<MDA	-0.09	---	<MDA	-63.61	---	<MDA	-0.14	---	<MDA	-290.8	---	<MDA	-25.72	---	<MDA	-128.8	---	<MDA	-15.98	---
S-82	Feb-96	unfiltered	0.22			---	---	---	0.43			---	---	---	---	---	---	---	---	---	---	---	---
S-82	May-96	Filtered	<MDA	-0.19	---	---	---	---	<MDA	-0.17	---	---	---	---	---	---	---	---	---	---	---	---	---
S-82	May-96	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-82	May-97	Filtered	<MDA	-0.004	---	1.39			<MDA	-0.015	---	---	---	---	<MDA	-24.3	---	<MDA	-173	---	<MDA	-14.9	---
S-82	May-97	unfiltered	0.085			1.07			0.048			---	---	---	<MDA	-18.1	---	<MDA	-213	---	<MDA	-12.2	---
S-82	May-97	unfiltered	0.093			1.31			0.023			---	---	---	<MDA	-20.3	---	<MDA	-209	---	<MDA	-15.1	---
S-84	Nov-95	Filtered	<MDA	-0.432	---	<MDA	-39.4	---	<MDA	-0.5	---	<MDA	-153.6	---	<MDA	-12.49	---	<MDA	-85.09	---	<MDA	-11.31	---
S-84	Nov-95	unfiltered	<MDA	-0.76	---	<MDA	-50.95	---	<MDA	-0.72	---	---	---	---	<MDA	-16.52	---	<MDA	-93.65	---	<MDA	-13.57	---
S-84	Feb-96	Filtered	<MDA	-0.12	---	<MDA	-34.28	---	<MDA	-0.12	---	<MDA	-194.3	---	<MDA	-19.15	---	<MDA	-78.44	---	<MDA	-13.01	---
S-84	Feb-96	unfiltered	0.14			---	---	---	<MDA	-0.19	---	---	---	---	---	---	---	---	---	---	---	---	---
S-84	May-96	Filtered	<MDA	-0.08	---	---	---	---	<MDA	-0.15	---	---	---	---	---	---	---	---	---	---	---	---	---
S-84	May-96	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-84 DUP (F)	Nov-95	Filtered	---	---	---	<MDA	-43.12	---	---	---	---	<MDA	-205.9	---	<MDA	-18.78	---	<MDA	-68.72	---	11.1		
S-84 DUP (F)	Nov-95	unfiltered	---	---	---	<MDA	-56.36	---	---	---	---	---	---	---	<MDA	-16.69	---	<MDA	-102.6	---	<MDA	-14.13	---
S-84 DUP (F)	Feb-96	Filtered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-84 DUP (F)	Feb-96	unfiltered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
S-84 DUP (F)	May-96	Filtered	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

Table C-5 : Groundwater Analytical Results - Thorium-232 Decay Series

Monitoring Well	Date	Filtered	Thorium-232			Radium-228			Thorium-228			Radium-224			Lead-212			Bismuth-212			Thallium-208		
			Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma
S-84 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-101	Nov-95	Filtered	<MDA	-0.34	—	<MDA	-42.75	—	<MDA	-0.48	—	<MDA	-152.9	—	<MDA	-15.12	—	<MDA	-80.88	—	<MDA	-11.23	—
MW-101	Nov-95	unfiltered	<MDA	-0.22	—	<MDA	-41.24	—	<MDA	-0.24	—	—	—	—	<MDA	-14.05	—	<MDA	-90.96	—	<MDA	-10.54	—
MW-101	Feb-96	Filtered	<MDA	-0.11	—	<MDA	-45.04	—	<MDA	-0.15	—	<MDA	-174.9	—	<MDA	-15.78	—	<MDA	-89.76	—	<MDA	-12.44	—
MW-101	Feb-96	unfiltered	<MDA	-0.17	—	—	—	—	<MDA	-0.33	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-101	May-96	Filtered	<MDA	-0.11	—	—	—	—	<MDA	-0.15	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-101	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107	Nov-95	Filtered	<MDA	-1.2	—	<MDA	-22.37	—	<MDA	-1.05	—	<MDA	-96.18	—	<MDA	-10.38	—	<MDA	-43.46	—	<MDA	-6.43	—
MW-107	Nov-95	unfiltered	**1.05**			<MDA	-22.77	—	<MDA	-0.55	—	—	—	—	<MDA	-11.46	—	<MDA	-48.11	—	<MDA	-6.63	—
MW-107	Feb-96	Filtered	**0.14**			<MDA	-51.84	—	<MDA	-0.14	—	<MDA	-198	—	<MDA	-19.53	—	<MDA	-103	—	<MDA	-13.46	—
MW-107	Feb-96	unfiltered	**0.37**			—	—	—	**0.44**			—	—	—	—	—	—	—	—	—	—	—	—
MW-107	May-96	Filtered	<MDA	-0.16	—	—	—	—	<MDA	-0.13	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107 DUP (F)	Nov-95	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107 DUP (F)	Nov-95	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107 DUP (F)	Feb-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107 DUP (F)	May-96	Filtered	<MDA	-0.21	—	—	—	—	<MDA	-0.2	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-107 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-F3	Nov-95	Filtered	<MDA	-5.81	—	<MDA	-39.3	—	**8.33**			<MDA	-190	—	<MDA	-18.26	—	<MDA	-80.77	—	<MDA	-13.45	—
MW-F3	Nov-95	unfiltered	<MDA	-4.64	—	<MDA	-81.01	—	**8.23**			—	—	—	<MDA	-31.54	—	<MDA	-172.3	—	<MDA	-23.85	—
MW-F3	Feb-96	Filtered	<MDA	-0.1	—	<MDA	-40.71	—	<MDA	-0.28	—	<MDA	-246.2	—	<MDA	-21.53	—	<MDA	-80.54	—	<MDA	-14.08	—
MW-F3	Feb-96	unfiltered	**0.22**			—	—	—	**0.31**			—	—	—	—	—	—	—	—	—	—	—	—
MW-F3	May-96	Filtered	<MDA	-0.05	—	—	—	—	<MDA	-0.13	—	—	—	—	—	—	—	—	—	—	—	—	—
MW-F3	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
PZ-114-AS	Nov-95	Filtered	0.95			<MDA	-48.16	—	<MDA	-0.93	—	<MDA	-132.6	—	<MDA	-14.4	—	<MDA	-80.79	—	<MDA	-10.26	—
PZ-114-AS	Nov-95	unfiltered	1.36			<MDA	-40.94	—	<MDA	-0.947	—	—	—	—	<MDA	-17.33	—	<MDA	-74.16	—	<MDA	-12.86	—
PZ-114-AS	Feb-96	Filtered	<MDA	-0.1	—	<MDA	-57.36	—	<MDA	-0.1	—	<MDA	-217.7	—	<MDA	-18.97	—	<MDA	-117.3	—	<MDA	-14.6	—
PZ-114-AS	Feb-96	unfiltered	0.37			—	—	—	0.25			—	—	—	—	—	—	—	—	—	—	—	—
PZ-114-AS	May-96	Filtered	<MDA	-0.23	—	—	—	—	<MDA	-0.21	—	—	—	—	—	—	—	—	—	—	—	—	—
PZ-114-AS	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Intermediate Depth Wells					—			—			—			—			—			—			—
I-2	Nov-95	Filtered	<MDA	-0.33	—	<MDA	-21.88	—	**7.3**			<MDA	-104.2	—	<MDA	-9.58	—	<MDA	-47.73	—	<MDA	-6.68	—
I-2	Nov-95	unfiltered	<MDA	-0.53	—	<MDA	-23.98	—	**8.22**			—	—	—	<MDA	-10.63	—	<MDA	-47.14	—	<MDA	-67.62	—
I-2	Feb-96	Filtered	<MDA	-0.22	—	<MDA	-51.73	—	<MDA	-0.21	—	<MDA	-196.7	—	<MDA	-17.96	—	<MDA	-81.48	—	<MDA	-14.15	—
I-2	Feb-96	unfiltered	<MDA	-0.1	—	—	—	—	**0.33**			<MDA	—	—	—	—	—	—	—	—	—	—	—
I-2	May-96	Filtered	<MDA	-0.07	—	—	—	—	<MDA	-0.14	—	—	—	—	—	—	—	—	—	—	—	—	—
I-2	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-2	May-97	Filtered	**0.009**			**2.08**			**0.032**			—	—	—	<MDA	-21.2	—	<MDA	-196	—	<MDA	-15.4	—
I-2	May-97	unfiltered	**0.026**			**2.58**			**0.043**			—	—	—	<MDA	-19.6	—	<MDA	-210	—	<MDA	-14.8	—
I-2-DUP	May-97	Filtered	**0.011**			**1.69**			**0.098**			—	—	—	<MDA	-22.8	—	<MDA	-189	—	<MDA	-16.4	—
I-2-DUP	May-97	unfiltered	**0.015**			**1.98**			**0.038**			—	—	—	<MDA	-23.4	—	<MDA	-220	—	<MDA	-14.2	—
I-4	Nov-95	Filtered	<MDA	-1.4	—	<MDA	-76.08	—	<MDA	-1.26	—	<MDA	-322	—	<MDA	-28.47	—	<MDA	-155.3	—	<MDA	-18.69	—
I-4	Nov-95	unfiltered	<MDA	-1.06	—	<MDA	-43.31	—	<MDA	-1.55	—	—	—	—	<MDA	-16.57	—	<MDA	-73.97	—	<MDA	-12.21	—
I-4	Feb-96	Filtered	**0.13**			<MDA	-51.25	—	<MDA	-0.16	—	<MDA	-230.6	—	<MDA	-19.57	—	<MDA	-101.8	—	<MDA	-15.32	—
I-4	Feb-96	unfiltered	<MDA	-0.1	—	—	—	—	**0.35**			—	—	—	—	—	—	—	—	—	—	—	—
I-4	May-96	Filtered	<MDA	-0.08	—	—	—	—	<MDA	-0.11	—	—	—	—	—	—	—	—	—	—	—	—	—
I-4	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-4	May-97	Filtered	**0.009**			**1.11**			**0.039**			—	—	—	<MDA	-17.8	—	<MDA	-188	—	<MDA	-11.8	—
I-4	May-97	unfiltered	**0.032**			**2.21**			**0.063**			—	—	—	<MDA	-23.8	—	<MDA	-160	—	<MDA	-11.4	—
I-4 DUP (F)	Nov-95	Filtered	—	—	—	<MDA	-43.14	—	—	—	—	<MDA	-206.4	—	<MDA	-18.99	—	<MDA	-78.42	—	<MDA	-12.07	—
I-4 DUP (F)	Nov-95	unfiltered	—	—	—	<MDA	-44.77	—	—	—	—	—	—	—	<MDA	-13.6	—	<MDA	-96.78	—	**11.92**		
I-4 DUP (F)	Feb-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-4 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-4 DUP (F)	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-4 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-7	Nov-95	Filtered	<MDA	-1.98	—	<MDA	-33.42	—	<MDA	-2.34	—	<MDA	-193.9	—	<MDA	-18.22	—	<MDA	-79.76	—	<MDA	-9.46	—
I-7	Nov-95	unfiltered	**0.24**			<MDA	-64.1	—	<MDA	-0.171	—	—	—	—	<MDA	-28.96	—	<MDA	-150.4	—	<MDA	-15.58	—
I-7	Feb-96	Filtered	<MDA	-0.16	—	<MDA	-70.51	—	<MDA	-0.15	—	<MDA	-337	—	<MDA	-29.51	—	<MDA	-113.2	—	<MDA	-12.89	—
I-7	Feb-96	unfiltered	**0.22**			—	—	—	<MDA	-0.22	—	—	—	—	—	—	—	—	—	—	—	—	—
I-7	May-96	Filtered	<MDA	-0.16	—	—	—	—	<MDA	-0.16	—	—	—	—	—	—	—	—	—	—	—	—	—
I-7	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-9	Nov-95	Filtered	<MDA	-0.74	—	<MDA	-21.59	—	**8.01**			<MDA	-83.09	—	<MDA	-8.57	—	<MDA	-46.75	—	<MDA	-4.3	—
I-9	Nov-95	unfiltered	<MDA	-0.6	—	<MDA	-42.95	—	**7.29**			—	—	—	<MDA	-17.48	—	<MDA	-90.82	—	<MDA	-12.09	—
I-9	Feb-96	Filtered	<MDA	-0.1	—	<MDA	-45.77	—	<MDA	-0.14	—	<MDA	-189.4	—	<MDA	-17.36	—	<MDA	-101.5	—	<MDA	-12.06	—
I-9	Feb-96	unfiltered	<MDA	-0.24	—	—	—	—	<MDA			—	—	—	—	—	—	—	—	—	—	—	—
I-9	May-96	Filtered	<MDA	-0.2	—	—	—	—	<MDA	-0.15	—	—	—	—	—	—	—	—	—	—	—	—	—
I-9	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-11	Nov-95	Filtered	<MDA	-0.49	—	<MDA	-47.45	—	<MDA	-0.7	—	<MDA	-179.8	—	<MDA	-17.9	—	<MDA	-111.5	—	<MDA	-12.2	—

Table C-5 : Groundwater Analytical Results - Thorium-232 Decay Series

Monitoring Well	Date	Filtered	Thorium-232 Result	Thorium-232 MDA	Thorium-232 +/- Sigma	Radium-228 Result	Radium-228 MDA	Radium-228 +/- Sigma	Thorium-228 Result	Thorium-228 MDA	Thorium-228 +/- Sigma	Radium-224 Result	Radium-224 MDA	Radium-224 +/- Sigma	Lead-212 Result	Lead-212 MDA	Lead-212 +/- Sigma	Bismuth-212 Result	Bismuth-212 MDA	Bismuth-212 +/- Sigma	Thallium-208 Result	Thallium-208 MDA	Thallium-208 +/- Sigma
I-11	Nov-95	unfiltered	<MDA	-0.44	—	<MDA	-48.54	—	<MDA	-0.42	—	—	—	—	<MDA	-18.48	—	<MDA	-10.33	—	<MDA	-13.5	—
I-11	Feb-96	Filtered	<MDA	-0.1	—	<MDA	-42.6	—	<MDA	-0.14	—	<MDA	-142.8	—	<MDA	-15.9	—	<MDA	-95.63	—	<MDA	-11.14	—
I-11	Feb-96	unfiltered	<MDA	-0.14	—	—	—	—	**0.21**			—	—	—	—	—	—	—	—	—	—	—	—
I-11	May-96	Filtered	<MDA	-0.14	—	—	—	—	<MDA	-0.1	—	—	—	—	—	—	—	—	—	—	—	—	—
I-11	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-62	Nov-95	Filtered	<MDA	-0.41	—	<MDA	-26.73	—	<MDA	-0.52	—	<MDA	-109.1	—	<MDA	-9.95	—	<MDA	-55.35	—	<MDA	-6.3	—
I-62	Nov-95	unfiltered	<MDA	-0.32	—	<MDA	-22.21	—	<MDA	-0.47	—	—	—	—	<MDA	-9.01	—	<MDA	-95.13	—	<MDA	-6.5	—
I-62	Feb-96	Filtered	<MDA	-0.23	—	<MDA	-35.31	—	<MDA	-0.19	—	<MDA	-148	—	<MDA	-15.3	—	<MDA	-87.44	—	<MDA	-11.48	—
I-62	Feb-96	unfiltered	<MDA	-0.28	—	—	—	—	<MDA	-0.39	—	—	—	—	—	—	—	—	—	—	—	—	—
I-62	May-96	Filtered	<MDA	-0.08	—	—	—	—	<MDA	-0.15	—	—	—	—	—	—	—	—	—	—	—	—	—
I-62	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-65	Nov-95	Filtered	<MDA	-0.2	—	<MDA	-37.29	—	<MDA	-0.328	—	<MDA	-154.6	—	<MDA	-15.8	—	<MDA	-57.82	—	<MDA	-11.92	—
I-65	Nov-95	unfiltered	<MDA	-0.51	—	<MDA	-39.23	—	<MDA	-0.409	—	—	—	—	<MDA	-15.48	—	<MDA	-85.16	—	<MDA	-12.1	—
I-65	Feb-96	Filtered	<MDA	-0.1	—	<MDA	-48.27	—	<MDA	-0.15	—	<MDA	-215.4	—	<MDA	-18.63	—	<MDA	-105.1	—	<MDA	-12.88	—
I-65	Feb-96	unfiltered	<MDA	-0.16	—	—	—	—	<MDA	-0.21	—	—	—	—	—	—	—	—	—	—	—	—	—
I-65	May-96	Filtered	<MDA	-0.1	—	—	—	—	<MDA	-0.13	—	—	—	—	—	—	—	—	—	—	—	—	—
I-65	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-66	Nov-95	Filtered	<MDA	-1.96	—	<MDA	-51.48	—	<MDA	-1.84	—	<MDA	-206.5	—	<MDA	-18.94	—	<MDA	-95.45	—	<MDA	-13.78	—
I-66	Nov-95	unfiltered	<MDA	-2.24	—	<MDA	-41.27	—	<MDA	-2.07	—	—	—	—	<MDA	-17.98	—	<MDA	-101.4	—	<MDA	-13.89	—
I-66	Feb-96	Filtered	<MDA	-0.11	—	<MDA	-46.52	—	<MDA	-0.16	—	<MDA	-197.2	—	<MDA	-18.82	—	<MDA	-88.17	—	<MDA	-13.07	—
I-66	Feb-96	unfiltered	<MDA	-0.67	—	—	—	—	<MDA	-0.57	—	—	—	—	—	—	—	—	—	—	—	—	—
I-66	May-96	Filtered	<MDA	-0.28	—	—	—	—	<MDA	-0.35	—	—	—	—	—	—	—	—	—	—	—	—	—
I-66	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-66 DUP (F)	Nov-95	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-66 DUP (F)	Nov-95	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-66 DUP (F)	Feb-96	Filtered	<MDA	-0.09	—	<MDA	-45.78	—	<MDA	-0.14	—	<MDA	-117	—	<MDA	-17.96	—	<MDA	-82.43	—	<MDA	-11.71	—
I-66 DUP (F)	Feb-96	unfiltered	<MDA	-0.25	—	—	—	—	<MDA	-0.17	—	—	—	—	—	—	—	—	—	—	—	—	—
I-66 DUP (F)	May-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-66 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-67	Nov-95	Filtered	<MDA	-1.29	—	<MDA	-45.78	—	<MDA	-1.72	—	<MDA	-102	—	<MDA	-15.53	—	<MDA	-72.87	—	<MDA	-11.86	—
I-67	Nov-95	unfiltered	<MDA	-0.5	—	<MDA	-37.4	—	<MDA	-0.8	—	—	—	—	<MDA	-19.17	—	<MDA	-90.3	—	<MDA	-12.14	—
I-67	Feb-96	Filtered	<MDA	-0.1	—	<MDA	-52.33	—	<MDA	-0.14	—	<MDA	-229.3	—	<MDA	-20.25	—	<MDA	-97.23	—	<MDA	-13.92	—
I-67	Feb-96	unfiltered	<MDA	-0.26	—	—	—	—	<MDA	-0.26	—	—	—	—	—	—	—	—	—	—	—	—	—
I-67	May-96	Filtered	<MDA	-0.08	—	—	—	—	<MDA	-0.15	—	—	—	—	—	—	—	—	—	—	—	—	—
I-67	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-68	Nov-95	Filtered	<MDA	-0.726	—	<MDA	-46.86	—	<MDA	-0.91	—	<MDA	-191.2	—	<MDA	-17.8	—	<MDA	-92.11	—	<MDA	-13.86	—
I-68	Nov-95	unfiltered	<MDA	-0.514	—	<MDA	-47.73	—	<MDA	-0.627	—	—	—	—	<MDA	-18.07	—	<MDA	-103	—	<MDA	-13.05	—
I-68	Feb-96	Filtered	<MDA	-0.13	—	<MDA	-51.01	—	<MDA	-0.19	—	<MDA	-198.6	—	<MDA	-17.91	—	<MDA	-94.11	—	<MDA	-14.88	—
I-68	Feb-96	unfiltered	<MDA	-0.14	—	—	—	—	<MDA	-0.15	—	—	—	—	—	—	—	—	—	—	—	—	—
I-68	May-96	Filtered	<MDA	-0.16	—	—	—	—	<MDA	-0.17	—	—	—	—	—	—	—	—	—	—	—	—	—
I-68	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-68 DUP (F)	Nov-95	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-68 DUP (F)	Nov-95	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-68 DUP (F)	Feb-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-68 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
I-68 DUP (F)	May-96	Filtered	<MDA	-0.07	—	—	—	—	<MDA	-0.14	—	—	—	—	—	—	—	—	—	—	—	—	—
I-68 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Deep Depth Wells					—			—			—			—			—			—			—
D-3	Nov-95	Filtered	<MDA	-0.6	—	<MDA	-67.18	—	<MDA	-0.71	—	<MDA	-30.52	—	<MDA	-27.59	—	<MDA	-131.1	—	<MDA	-17.46	—
D-3	Nov-95	unfiltered	<MDA	-0.3	—	<MDA	-51.73	—	<MDA	-0.56	—	—	—	—	<MDA	-12.33	—	<MDA	-66.83	—	<MDA	-10.8	—
D-3	Feb-96	Filtered	<MDA	-0.22	—	<MDA	-42.02	—	<MDA	-0.22	—	<MDA	-146	—	<MDA	-15.3	—	<MDA	-88.87	—	<MDA	-8.98	—
D-3	Feb-96	unfiltered	<MDA	-0.09	—	—	—	—	**0.22**			—	—	—	—	—	—	—	—	—	—	—	—
D-3	May-96	Filtered	<MDA	-0.09	—	—	—	—	<MDA	-0.14	—	—	—	—	—	—	—	—	—	—	—	—	—
D-3	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
D-3	May-97	Filtered	**0.00**			**2.55**			**0.1**			—	—	—	<MDA	-20.2	—	<MDA	-173	—	<MDA	[illegible]	—
D-3	May-97	unfiltered	<MDA	-0.02	—	**3.43**			**0.11**			—	—	—	<MDA	-19.1	—	<MDA	-174	—	<MDA	[illegible]	—
D-3 DUP (F)	Nov-95	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
D-3 DUP (F)	Nov-95	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
D-3 DUP (F)	Feb-96	Filtered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
D-3 DUP (F)	Feb-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
D-3 DUP (F)	May-96	Filtered	<MDA	-0.1	—	—	—	—	**0.12**			—	—	—	—	—	—	—	—	—	—	—	—
D-3 DUP (F)	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
D-6	Nov-95	Filtered	<MDA	-0.259	—	<MDA	-43.52	—	<MDA	-0.494	—	<MDA	-194.1	—	<MDA	-17.74	—	<MDA	-86.5	—	<MDA	-13.95	—
D-6	Nov-95	unfiltered	<MDA	-0.3	—	<MDA	-47.22	—	<MDA	-0.35	—	—	—	—	<MDA	-16.06	—	<MDA	-86.2	—	<MDA	-12.51	—
D-6	Feb-96	Filtered	<MDA	-0.12	—	<MDA	-48.98	—	**0.16**			<MDA	-240.1	—	<MDA	-21.72	—	<MDA	-111.6	—	<MDA	-11.31	—
D-6	Feb-96	unfiltered	<MDA	-0.13	—	—	—	—	**0.23**			—	—	—	—	—	—	—	—	—	—	—	—
D-6	May-96	Filtered	<MDA	-0.1	—	—	—	—	<MDA	-0.14	—	—	—	—	—	—	—	—	—	—	—	—	—
D-6	May-96	unfiltered	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
D-6	May-97	Filtered	**0.012**			**3.6**			**0.16**			—	—	—	<MDA	-17.5	—	<MDA	-191	—	<MDA	-14	—

Table C-5 : Groundwater Analytical Results - Thorium-232 Decay Series

Monitoring Well	Date	Filtered	Thorium-232			Radium-228			Thorium-228			Radium-224			Lead-212			Bismuth-212			Thallium-208		
			Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma	Result	MDA	+/- Sigma
D-6	May-97	unfiltered	**0.067**			**3.93**			**0.098**			----	----	----	<MDA	-10.1	----	<MDA	-108	----	<MDA	-7.91	----
D-12	Nov-95	Filtered	<MDA	-0.52	----	<MDA	-24.51	----	<MDA	-0.63	----	<MDA	-103.5	----	<MDA	-9.45	----	<MDA	-45.8	----	<MDA	-6.85	----
D-12	Nov-95	unfiltered	<MDA	-2.36	----	<MDA	-27.63	----	<MDA	-2.56	----	----	----	----	<MDA	-9.65	----	<MDA	-56.47	----	<MDA	-7.52	----
D-12	Feb-96	Filtered	**1.25**			<MDA	-53.45	----	<MDA	-0.34	----	<MDA	-216.8	----	<MDA	-19.39	----	<MDA	-120.2	----	<MDA	-14.76	----
D-12	Feb-96	unfiltered	<MDA	-0.12	----	----	----	----	<MDA	-0.13	----	----	----	----	----	----	----	----	----	----	----	----	----
D-12	May-96	Filtered	<MDA	-0.11	----	----	----	----	<MDA	-0.13	----	----	----	----	----	----	----	----	----	----	----	----	----
D-12	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-12	May-97	Filtered	**0.02**			**0.47**			<MDA	-0.23	----	----	----	----	<MDA	-21.7	----	<MDA	-198	----	<MDA	-13.2	----
D-12	May-97	Filtered	**0**			**0.67**			**0.05**			----	----	----	<MDA	-19.2	----	<MDA	-236	----	<MDA	-14.9	----
D-12	May-97	unfiltered	**0.042**			**0.62**			**0.04**			----	----	----	<MDA	-21.3	----	<MDA	-206	----	<MDA	-13.3	----
D-13	Nov-95	Filtered	<MDA	-1.79	----	<MDA	-40.97	----	**6.06**			<MDA	-128	----	<MDA	-16.33	----	<MDA	-77.42	----	<MDA	-10.13	----
D-13	Nov-95	unfiltered	<MDA	-2.11	----	<MDA	-53.85	----	**9.31**			----	----	----	<MDA	-16.98	----	<MDA	-94.22	----	<MDA	-12.74	----
D-13	Feb-96	Filtered	<MDA	-0.08	----	<MDA	-48.24	----	<MDA	-0.098	----	<MDA	-187.7	----	<MDA	-16.64	----	<MDA	-88.49	----	<MDA	-12.43	----
D-13	Feb-96	unfiltered	**0.11**			----	----	----	**0.14**			----	----	----	----	----	----	----	----	----	----	----	----
D-13	May-96	Filtered	<MDA	-0.07	----	----	----	----	<MDA	-0.1	----	----	----	----	----	----	----	----	----	----	----	----	----
D-13	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-14	Nov-95	Filtered	<MDA	-1.96	----	<MDA	-51.91	----	<MDA	-1.82	----	<MDA	-188	----	<MDA	-19.51	----	<MDA	-19.51	----	<MDA	-12.27	----
D-14	Nov-95	unfiltered	<MDA	-0.35	----	<MDA	-47.81	----	<MDA	-0.58	----	----	----	----	<MDA	-20.56	----	<MDA	-102.2	----	<MDA	-12.86	----
D-14	Feb-96	Filtered	<MDA	-0.22	----	<MDA	-43.37	----	<MDA	-0.19	----	<MDA	-246.8	----	<MDA	-19.49	----	<MDA	-83.93	----	<MDA	-15.39	----
D-14	Feb-96	unfiltered	**0.38**			----	----	----	**0.31**			----	----	----	----	----	----	----	----	----	----	----	----
D-14	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-14	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-83	Nov-95	Filtered	<MDA	-0.44	----	<MDA	-23.39	----	<MDA	-0.41	----	<MDA	-79.67	----	<MDA	-8.26	----	<MDA	-38.24	----	<MDA	-6.42	----
D-83	Nov-95	unfiltered	**0.36**			<MDA	-40.34	----	<MDA	-0.32	----	----	----	----	<MDA	-18.49	----	<MDA	-84.77	----	<MDA	-12.63	----
D-83	Feb-96	Filtered	<MDA	-0.18	----	<MDA	-49.92	----	<MDA	-0.14	----	<MDA	-215.4	----	<MDA	-17.05	----	<MDA	-95.07	----	<MDA	-14.49	----
D-83	Feb-96	unfiltered	<MDA	-0.1	----	----	----	----	**0.22**			----	----	----	----	----	----	----	----	----	----	----	----
D-83	May-96	Filtered	<MDA	-0.07	----	----	----	----	<MDA	-0.13	----	----	----	----	----	----	----	----	----	----	----	----	----
D-83	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-85	Nov-95	Filtered	<MDA	2.48	----	<MDA	-50.18	----	<MDA	-2.53	----	<MDA	-197.2	----	<MDA	-18.78	----	<MDA	-89.36	----	<MDA	-11.19	----
D-85	Nov-95	unfiltered	<MDA	0.45	----	<MDA	-39.53	----	<MDA	-0.54	----	----	----	----	<MDA	-17.59	----	<MDA	-84.95	----	<MDA	-12.04	----
D-85	Feb-96	Filtered	<MDA	-0.13	----	<MDA	-81.61	----	<MDA	-0.16	----	<MDA	-385.2	----	<MDA	-32.62	----	<MDA	-167.5	----	<MDA	-21.03	----
D-85	Feb-96	unfiltered	<MDA	-0.08	----	----	----	----	**0.08**			----	----	----	----	----	----	----	----	----	----	----	----
D-85	May-96	Filtered	<MDA	-0.18	----	----	----	----	<MDA	-0.13	----	----	----	----	----	----	----	----	----	----	----	----	----
D-85	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-85 DUP (F)	Nov-95	Filtered	----	----	----	<MDA	-51.2	----	----	----	----	<MDA	-186	----	<MDA	-18.35	----	<MDA	-100.3	----	<MDA	-13.86	----
D-85 DUP (F)	Nov-95	unfiltered	----	----	----	<MDA	-40.27	----	----	----	----	----	----	----	<MDA	-16.75	----	<MDA	-78.79	----	<MDA	-11.15	----
D-85 DUP (F)	Feb-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-85 DUP (F)	Feb-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-85 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-85 DUP (F)	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-93	Nov-95	Filtered	<MDA	-0.29	----	<MDA	-48.6	----	**6.48**			<MDA	-179.4	----	<MDA	-16.34	----	<MDA	-91.25	----	<MDA	-11.53	----
D-93	Nov-95	unfiltered	<MDA	-0.17	----	<MDA	-44.32	----	**7.48**			----	----	----	<MDA	-17.79	----	<MDA	-99.16	----	<MDA	-12.36	----
D-93	Feb-96	Filtered	<MDA	-0.079	----	<MDA	-43.9	----	<MDA	-0.13	----	<MDA	-198.2	----	<MDA	-17.48	----	<MDA	-82.58	----	<MDA	-11.5	----
D-93	Feb-96	unfiltered	<MDA	-0.21	----	----	----	----	<MDA	-0.2	----	----	----	----	----	----	----	----	----	----	----	----	----
D-93	May-96	Filtered	<MDA	-0.13	----	----	----	----	**0.16**			----	----	----	----	----	----	----	----	----	----	----	----
D-93	May-96	unfiltered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-93	May-97	Filtered	**0.08**			**2.59**			**0.03**			----	----	----	<MDA	-19.4	----	<MDA	-222	----	<MDA	-13.4	----
D-93	May-97	unfiltered	**0.062**			**2.61**			**0.071**			----	----	----	<MDA	-9.9	----	<MDA	-99.6	----	<MDA	-7.53	----
D-93 DUP (F)	Nov-95	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
D-93 DUP (F)	Feb-96	Filtered	<MDA	-0.15	----	<MDA	-60.82	----	<MDA	-0.2	----	<MDA	-323.3	----	<MDA	-28.13	----	<MDA	-148.1	----	<MDA	-17.49	----
D-93 DUP (F)	Feb-96	unfiltered	<MDA	-0.56	----	----	----	----	**0.56**			----	----	----	----	----	----	----	----	----	----	----	----
D-93 DUP (F)	May-96	Filtered	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----

All values expressed as pCi/L, unless otherwise noted

---- = not analyzed

MDA = Minimum Detectable Activity

Bold numbers indicate results above the MDA

xx = No tracer counts. Therefore, results could not be generated

Table C-6 : Split Groundwater Analytical Results - Uranium-238 Decay Series

Monitoring Well	Uranium-238											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	MDA	--	0.45	**0.1**		0.1	MDA	--	2.85	**0.1**		0.1
MW-101	**1.29**		0.11	**1.1**		0.1	**1.24**		0.23	**1.1**		0.1
MW-107	**0.15**		0.11	MDA	--	0.1	**0.39**		0.14	MDA	--	0.1
MW-F3	MDA	--	0.25	MDA		0.1	**1.24**		0.23	MDA	-	0.1

Monitoring Well	Thorium-234											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	MDA	--	191	MDA	--	112	MDA	--	233	MDA	-	66
MW-101	MDA	--	140	MDA	-	118	MDA	--	93	MDA	--	107
MW-107	MDA	-	353	MDA	--	120	MDA	--	147	MDA	--	108
MW-F3	MDA	--	234	MDA	--	121	MDA	--	192	MDA		110

Monitoring Well	Uranium-234											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	MDA	--	0.39	**0.1**		0.1	MDA	--	3.91	**0.1**		0.1
MW-101	**1.43**		0.11	**1.8**		0.1	**1.89**		0.17	**1.7**		0.1
MW-107	**0.23**		0.13	**0.2**		0.1	**0.53**		0.15	**0.2**		0.1
MW-F3	MDA	-	0.22	MDA	--	0.1	MDA	--	0.61	MDA	-	0.1

Monitoring Well	Thorium-230											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	**0.51**		0.23	**0.1**		0.1	**0.48**		0.17	**0.2**		0.1
MW-101	**0.19**		0.09	**0.5**		0.1	**0.38**		0.13	MDA	--	0.1
MW-107	**0.49**		0.11	**0.2**		0.1	**0.24**		0.11	**0.1**		0.1
MW-F3	**0.22**		0.09	**0.2**		0.1	**0.59**		0.08	**0.2**		0.1

Monitoring Well	Radium-226											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	**0.80**		0.07	**0.9**		0.4	**0.20**		0.07	**0.7**		0.5
MW-101	**0.31**		0.07	**0.3**		0.3	**0.25**		0.09	MDA	--	0.3
MW-107	**0.39**		0.07	**0.3**		0.3	**0.17**		0.07	MDA	-	0.3
MW-F3	**1.35**		0.07	**0.6**		0.3	**1.34**		0.06	**0.8**		0.3

Monitoring Well	Lead-214											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	MDA	--	21.3	MDA	--	15	MDA	--	23.5	MDA	--	10
MW-101	MDA	--	29.9	MDA	--	17	MDA	--	20.5	MDA	--	15
MW-107	MDA	--	39.4	MDA	--	18	MDA	--	41.2	MDA	--	15
MW-F3	MDA	--	41.3	MDA	--	18	MDA	--	26	MDA	--	15

Monitoring Well	Bismuth-214											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	MDA	--	24.1	MDA	--	16	MDA	--	27.6	MDA	--	10
MW-101	MDA	--	37	MDA	-	24	MDA	--	33.9	MDA	--	16
MW-107	MDA	--	63.6	MDA	--	24	**82.1**		37.1	MDA	--	15
MW-F3	MDA	--	30.7	MDA	--	25	MDA	--	28.6	MDA	--	13

Monitoring Well	Lead-210											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	MDA	--	292	MDA	--	150	MDA	-	1300	MDA	--	76
MW-101	MDA	--	156	MDA	--	130	MDA	--	139	MDA	-	140
MW-107	MDA	--	3860	MDA	--	130	MDA	--	226	MDA	--	150
MW-F3	MDA	--	1300	MDA	--	128	MDA	--	304	MDA	--	133

All results expressed as pCi/L unless otherwise noted
-- = Not reported
MDA = Minimum detectable activity
Bolded numbers indicate result reported above the minimum detectable activity

Table C-7 : Split Groundwater Analytical Results - Uranium-235 Decay Series

Monitoring Well	Uranium-235/236											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	< MDA	--	0.46	< MDA	--	0.1	< MDA	--	3.57	< MDA	--	0.1
MW-101	**0.18**		0.14	< MDA	--	0.1	< MDA	--	0.30	< MDA	--	0.1
MW-107	**0.10**		0.09	< MDA	--	0.1	< MDA	--	0.17	< MDA	--	0.1
MW-F3	< MDA	--	0.29	< MDA	--	0.1	< MDA	--	0.74	**0.1**		0.1

Monitoring Well	Uranium-235											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	< MDA	--	62.7	< MDA	--	14	< MDA	--	68.3	< MDA	--	8.6
MW-101	< MDA	--	53.3	< MDA	--	13	< MDA	--	49.5	< MDA	--	13
MW-107	< MDA	--	133	< MDA	--	14	< MDA	--	57.4	< MDA	--	14
MW-F3	< MDA	--	70.7	< MDA	--	14	< MDA	--	62.8	**12**		12

Monitoring Well	Protactinium-231											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	< MDA	--	291	< MDA	--	350	< MDA	--	338	< MDA	--	230
MW-101	< MDA	--	286	< MDA	--	420	< MDA	--	297	< MDA	--	330
MW-107	< MDA	--	640	< MDA	--	460	< MDA	--	355	< MDA	--	330
MW-F3	< MDA	--	314	< MDA	--	430	< MDA	--	275	< MDA	--	380

Monitoring Well	Actinium-227											
	Unfiltered						Filtered					
	Quanterra			Accu-labs 1			Quanterra			Accu-Labs 1		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	< MDA	--	54.6	--	--	--	< MDA	--	65.8	--	--	--
MW-101	< MDA	--	61.1	--	--	--	< MDA	--	55.8	--	--	--
MW-107	< MDA	--	125	--	--	--	< MDA	--	65.2	--	--	--
MW-F3	< MDA	--	68	--	--	--	< MDA	--	60.6	--	--	--

Monitoring Well	Radium-223											
	Unfiltered						Filtered					
	Quanterra			Accu-labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	< MDA	--	283	< MDA	--	14	< MDA	--	273	< MDA	--	8.3
MW-101	< MDA	--	300	< MDA	--	30	< MDA	--	245	< MDA	--	18
MW-107	< MDA	--	628	< MDA	--	31	< MDA	--	361	< MDA	--	14
MW-F3	< MDA	--	274	< MDA	--	30	< MDA	--	260	< MDA	--	16

All results expressed as pCi/L, unless otherwise noted.
1 = Accu-Labs actinium-227's energy and photon yield were too low to be seen on Accu-Labs gamma detectors.
-- = Not reported
MDA = Minimum detectable activity
Bolded numbers indicate result reported above the minimum detectable activity

Table C-8 : Split Groundwater Analytical Results - Thorium-232 Decay Series

Monitoring Well	Thorium-232											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	MDA	--	0.22	MDA	–	0.1	MDA	–	0.14	MDA	–	0.1
MW-101	MDA	--	0.07	MDA	–	0.1	MDA	–	0.099	MDA	–	0.1
MW-107	MDA	--	0.11	**0.1**		0.1	MDA	--	0.075	MDA	–	0.1
MW-F3	MDA	–	0.07	MDA	–	0.1	**0.08**		0.08	MDA	–	0.1

Monitoring Well	Radium-228											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs [1]			Quanterra			Accu-Labs [1]		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	MDA	–	42.9	--	--	–	MDA	--	42.3	--	–	–
MW-101	MDA	–	77.1	--	--	–	MDA	--	43.7	--	–	–
MW-107	MDA	–	48.5	--	--	–	MDA	–	50.3	--	--	–
MW-F3	MDA	–	41.8	--	–	–	MDA	–	40.8	–	--	--

Monitoring Well	Thorium-228											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	MDA	--	0.15	MDA	–	0.1	MDA	–	0.31	MDA	–	0.1
MW-101	MDA	--	0.13	MDA	–	0.1	MDA	–	0.14	MDA	--	0.1
MW-107	**0.15**		0.14	**0.1**		0.1	MDA	–	0.12	MDA	–	0.1
MW-F3	MDA	–	0.097	**0.1**		0.1	MDA	–	0.10	MDA	–	0.1

Monitoring Well	Radium-224											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs [2]			Quanterra			Accu-Labs [2]		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	MDA	–	193	–	–	–	MDA	–	192	–	–	–
MW-101	MDA	–	189	–	–	–	MDA	–	198	–	–	–
MW-107	MDA	–	351	–	–	–	MDA	–	225	–	–	–
MW-F3	MDA	–	195	–	–	–	MDA	–	179	–	–	–

Monitoring Well	Lead-212											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	MDA	--	16.5	MDA	–	14	MDA	–	18.4			8.3
MW-101	MDA	--	17.0	MDA	–	16	MDA	–	16.8			13
MW-107	MDA	--	35.5	MDA	–	17	MDA	–	18.5			13
MW-F3	MDA	–	18.1	MDA	–	17	MDA	--	17.7			12

Monitoring Well	Bismuth-212											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	MDA	--	85	MDA	–	200	MDA	–	85	MDA	–	130
MW-101	MDA	--	107	MDA	–	190	MDA	--	80	MDA	--	190
MW-107	MDA	–	111	MDA	–	200	MDA	--	104	MDA	–	190
MW-F3	MDA	-	85	MDA	–	190	MDA	--	84	MDA	–	170

Monitoring Well	Thallium-208											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	MDA	–	11.3	MDA	–	7.3	MDA	–	11.4	MDA	–	4.9
MW-101	MDA	–	13	MDA	–	8.2	MDA	–	10.2	MDA	–	7.5
MW-107	MDA	–	24.8	MDA	–	8.1	MDA	–	14.1	MDA	–	6.9
MW-F3	MDA	–	12.4	MDA	–	8.5	MDA	–	11.9	MDA	–	7.5

All results expressed as pCi/L, unless otherwise noted.

[1] = Radium-228 is not a gamma emitter so it does not show up on gamma spectrometry. However, radium-228 decays to actinium-228, which has three strong gamma peaks. The peak at 911 KeV is traditionally reported as the radium-228 concentration because of the equilibrium that exists between radium-228 and actinium-228.

[2] = Radium-224 has its highest gamma emitter at 240 KeV, and has a photon yield of less than 4%. There are two strong peaks that usually interfere with the radium-224 peak: lead-212 at 241 KeV and lead-212 at 238 KeV. Both of these peaks have higher photon yields which prevents the visibility of radium-224.

-- = Not reported. Result reported below the minimum

MDA = Minimum detectable activity

Bolded numbers indicate result reported above the minimum detectable activity.

Table C-9 : Split Groundwater Analytical Results - Gross Alpha

Monitoring Well	Gross Alpha											
	Unfiltered						Filtered					
	Quanterra			Accu-Labs			Quanterra			Accu-Labs		
	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
S-5	*< MDA*	--	*53.2*	*< MDA*	--	*23*	*< MDA*	--	*32.4*	*< MDA*	--	*27*
MW-101	**3.60**		*1.51*	**4**		*2*	**4.42**		*1.78*	*< MDA*	--	*3*
MW-107	**5.45**		*2.65*	*< MDA*	--	*9*	*< MDA*	--	*2.9*	**7**		*6*
MW-F3	**9.92**		*2.33*	**8**		*3*	**12.5**		*2.3*	**7**		*3*

All results expressed as pCi/L, unless otherwise noted.
-- = Not reported
MDA = Minimum detectable activity
Bolded numbers indicate results reported above the minimum detectable activity

Table C-10 : Split Groundwater Analytical Results - Priority Pollutant Metals

Monitoring Well	Arsenic				Chromium				Lead			
	Unfiltered		Filtered		Unfiltered		Filtered		Unfiltered		Filtered	
	MBT Result (ppb)	Accu-Labs Result (ppb)	MBT Result (ppb)	Accu-Labs Result (ppb)	MBT Result (ppb)	Accu-Labs Result (ppb)	MBT Result (ppb)	Accu-Labs Result (ppb)	MBT Result (ppb)	Accu-Labs Result (ppb)	MBT Result (ppb)	Accu-Labs Result (ppb)
S-5	**19**	**23**	**22**	**26**	**11**	**13**	**11**	**10**	**18**	**17**	< 3.0	< 50
MW-101	< 10	< 1	< 10	< 1	< 10	< 5	< 10	< 5	< 3.0	< 1	< 3.0	< 1
MW-107	< 10	**4**	< 10	**4**	< 10	**6**	< 10	< 5	< 3.0	**2**	< 3.0	< 1
MW-F3	**200**	**180**	**200**	**190**	< 10	< 5	< 10	< 5	< 3.0	< 50	< 3.0	< 50

Monitoring Well	Nickel				Thallium				Zinc			
	Unfiltered		Filtered		Unfiltered		Filtered		Unfiltered		Filtered	
	MBT Result (ppb)	Accu-Labs Result (ppb)	MBT Result (ppb)	Accu-Labs Result (ppb)	MBT Result (ppb)	Accu-Labs Result (ppb)	MBT Result (ppb)	Accu-Labs Result (ppb)	MBT Result (ppb)	Accu-Labs Result (ppb)	MBT Result (ppb)	Accu-Labs Result (ppb)
S-5	**84**	**80**	**86**	**90**	< 10	< 50	< 10	< 100	**56**	**57**	< 20	**11**
MW-101	< 20	< 10	< 20	< 10	< 10	< 50	< 10	< 100	< 20	**5**	< 20	< 5
MW-107	< 20	**10**	< 20	< 10	< 10	< 50	< 10	< 100	< 20	**11**	< 20	< 5
MW-F3	< 20	< 10	< 20	< 10	< 10	< 10	< 10	< 100	< 20	< 5	< 20	< 5

Copper was only detected in Accu-Labs Unfiltered S-5 (7 ppb).
The groundwater samples were additionally analyzed for Total Cyanide (USEPA method SW846-9010) but was not detected.
Bolded numbers indicate result reported above the reporting limit

Table C-11 : Split Groundwater Analytical Results - TPH, VOCs, and SVOCs

Total Petroleum Hydrocarbons

Monitoring Well	Diesel Range		Motor Oil Range	
	MBT	Accu-Labs	MBT	Accu-Labs
	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)
S-5	**3.2**	< 0.3	**1.1**	--
MW-101	< 0.50	< 0.3	< 0.50	--
MW-107	< 0.50	< 0.3	< 0.50	--
MW-F3	< 0.50	< 0.3	< 0.50	--

Volatile Organic Compounds

Monitoring Well	Toluene		m & p Xylene		o-Xylene		Chlorobenzene		1,4-Dichlorobenzene		Acetone	
	MBT	Accu-Labs	MBT	Accu-Labs	MBT	Accu-Labs	MBT	Accu-Labs	MBT	Accu-Labs	MBT	Accu-Labs
	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)
S-5	**5.5**	**9**	**9.2**	**22**	< 5.0	**6**	< 5.0	< 5	**5.1**	--	**33**	< 50
MW-101	< 5.0	< 5	< 5.0	< 5	< 5.0	< 5	< 5.0	< 5	< 5.0	--	< 25	< 50
MW-107	< 5.0	< 5	< 5.0	< 5	< 5.0	< 5	< 5.0	< 5	< 5.0	--	< 25	< 50
MW-F3	< 5.0	< 5	< 5.0	< 5	< 5.0	< 5	**32**	**30**	**8.2**	--	< 25	< 50

Semi-Volatile Organic Compounds

Monitoring Well	1,4-Dichlorobenzene		4-Methylphenol	3/4-Methylphenol
	MBT	Accu-Labs	MBT	Accu-Labs
	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)
S-5	< 20	< 10	**32**	< 10
MW-101	< 10	< 10	< 10	< 10
MW-107	< 10	< 10	< 10	< 10
MW-F3	< 11	< 10	< 11	< 10

-- = Not reported
Bolded numbers indicate result reported above the reporting limit

Table C-12 : Groundwater Analytical Results - Priority Pollutant Metals

Monitoring Well Number	Arsenic			Chromium			Copper			Lead			Nickel			Zinc		
	November 1995		February 1996	November 1995		February 1996	November 1995		February 1996	November 1995		February 1996	November 1995		February 1996	November 1995		February 1996
	Unfiltered	Filtered	Filtered	Unfiltered	Filtered	Filtered	Unfiltered	Filtered	Filtered	Unfiltered	Filtered	Filtered	Unfiltered	Filtered	Filtered	Unfiltered	Filtered	Filtered
Shallow Depth Wells																		
S-1	< 10	< 10	< 10	< 10	< 10	< 10	< 20	< 20	< 20	**3.1**	< 3.0	< 3.0	< 20	< 20	< 20	**28**	< 20	< 20
S-1 DUP (F)	--	--	< 10	--	--	< 10	--	--	< 20	--	--	< 3.0	--	--	< 20	--	--	**20**
S-5	**26**	**21**	**13**	< 10	< 10	**22**	< 20	< 20	< 20	**26**	< 3.0	**7.9**	**93**	**99**	**110**	< 20	**28**	**22**
S-8	< 10	< 10	< 10	< 10	< 10	< 10	< 20	< 20	< 20	**3.2**	< 3.0	< 3.0	< 20	< 20	< 20	**47**	< 20	< 20
S-10	**50**	**40**	**86**	**17**	**11**	**15**	< 20	< 20	< 20	< 3.0	< 3.0	< 3.0	**27**	**21**	< 20	**47**	< 20	< 20
S-61	< 10	< 10	< 10	< 10	< 10	< 10	< 20	< 20	< 20	**43**	< 3.0	< 3.0	< 20	< 20	**20**	< 20	< 20	< 20
S-80	**20**	< 10	< 10	**62**	< 10	< 10	**76**	< 20	20	< 3.0	< 3.0	< 3.0	**74**	< 20	< 20	**270**	< 20	< 20
S-82	**32**	**20**	**35**	10	< 10	< 10	< 20	< 20	< 20	**12**	< 3.0	< 3.0	**78**	**70**	**81**	**130**	< 20	**26**
S-84	**84**	**38**	**71**	< 10	< 10	< 10	< 20	< 20	< 20	**5.5**	< 3.0	< 3.0	< 20	< 20	< 20	< 20	< 20	< 20
S-84 DUP (F)	**79**	**60**	--	< 10	< 10	--	< 20	< 20	--	**4.4**	< 3.0	--	< 20	< 20	--	< 20	< 20	--
MW-101	< 10	< 10	< 10	< 10	< 10	< 10	< 20	< 20	< 20	< 3.0	< 3.0	< 3.0	< 20	< 20	< 20	**32**	< 20	< 20
MW-107	< 10	< 10	< 10	< 10	< 10	< 10	**23**	< 20	< 20	**17**	< 3.0	< 3.0	< 20	< 20	< 20	**63**	< 20	< 20
MW-F3	**420**	**400**	**260**	**30**	< 10	< 10	**59**	< 20	< 20	**70**	< 3.0	< 3.0	**44**	< 20	< 20	**310**	< 20	< 20
PZ-114-AS	**21**	**18**	**29**	**14**	< 10	< 10	< 20	< 20	< 20	**19**	< 3.0	< 3.0	**28**	< 20	< 20	**76**	< 20	< 20
Intermediate Depth Wells																		
I-2	< 10	< 10	**12**	< 10	< 10	< 10	< 20	< 20	< 20	< 3.0	< 3.0	< 3.0	< 20	< 20	< 20	**97**	< 20	< 20
I-4	< 10	< 10	< 10	**10**	< 10	< 10	< 20	< 20	< 20	**4.1**	**4.1**	< 3.0	< 20	< 20	< 20	**170**	< 20	< 20
I-4 DUP (F)	< 10	< 10	--	< 10	< 10	--	< 20	< 20	--	< 3.0	< 3.0	--	< 20	< 20	--	< 20	< 20	--
I-7	< 10	< 10	< 10	< 10	< 10	< 10	< 20	< 20	< 20	< 3.0	< 3.0	< 3.0	< 20	< 20	< 20	< 20	< 20	< 20
I-9	< 10	**11**	**10**	**14**	< 10	< 10	< 20	< 20	< 20	**8.7**	< 3.0	< 3.0	< 20	< 20	< 20	**67**	< 20	< 20
I-11	< 10	< 10	**14**	< 10	< 10	< 10	< 20	< 20	< 20	**6.1**	< 3.0	< 3.0	< 20	< 20	< 20	< 20	< 20	**49**
I-62	**58**	**23**	**19**	< 10	< 10	< 10	< 20	< 20	< 20	**5.5**	< 3.0	< 3.0	< 20	< 20	< 20	**44**	< 20	< 20
I-65	< 10	< 10	< 10	< 10	< 10	< 10	< 20	< 20	< 20	**40**	< 3.0	< 3.0	< 20	< 20	< 20	< 20	< 20	< 20
I-66	**21**	< 10	< 10	< 10	< 10	< 10	< 20	< 20	< 20	**4.3**	< 3.0	< 3.0	< 20	< 20	< 20	< 20	< 20	< 20
I-66 DUP (F)	--	--	< 10	--	--	--	--	--	--	--	--	< 3.0	--	--	--	--	--	--
I-67	**18**	**11**	< 10	< 10	< 10	< 10	< 20	< 20	< 20	< 3	< 3.0	< 3.0	< 20	< 20	< 20	**22**	< 20	< 20
I-68	< 10	< 10	< 10	< 10	< 10	< 10	< 20	< 20	< 20	**3.6**	< 3.0	< 3.0	< 20	< 20	< 20	< 20	< 20	< 20
Deep Depth Wells																		
D-3	< 10	< 10	< 10	**10**	10	< 10	< 20	< 20	< 20	< 3.0	< 3.0	< 3.0	< 20	< 20	< 20	**170**	< 20	< 20
D-6	< 10	< 10	< 10	< 10	< 10	< 10	< 20	< 20	< 20	< 3.0	< 3.0	< 3.0	**29**	**23**	< 20	**43**	< 20	< 20
D-12	< 10	< 10	< 10	< 10	< 10	< 10	< 20	< 20	< 20	**5.4**	< 3.0	< 3.0	**23**	< 20	< 20	< 20	< 20	< 20
D-13	< 10	< 10	< 10	< 10	< 10	< 10	< 20	< 20	< 20	**5.4**	< 3.0	< 3.0	< 20	< 20	< 20	< 20	< 20	< 20
D-14	**94**	**49**	**68**	**49**	< 10	< 10	**46**	< 20	< 20	**14**	< 3.0	< 3.0	**59**	**42**	**35**	**330**	< 20	< 20
D-83	< 10	< 10	< 10	< 10	< 10	< 10	**40**	< 20	< 20	**6.8**	< 3.0	< 3.0	< 20	< 20	< 20	**120**	**77**	< 20
D-85	**27**	**22**	**31**	**12**	< 10	< 10	< 20	< 20	< 20	< 3.0	< 3.0	< 3.0	< 20	< 20	< 20	< 20	< 20	< 20
D-85 DUP (F)	**28**	**23**	--	< 10	< 10	--	< 20	< 20	--	**9.7**	< 3.0	--	< 20	< 20	--	< 20	< 20	--
D-93	< 10	< 10	< 10	< 10	< 10	< 10	**23**	< 20	< 20	**16**	< 3.0	< 3.0	< 20	< 20	< 20	**120**	**37**	< 20
D-93 DUP (F)	--	--	< 10	--	--	< 10	--	--	< 20	--	--	< 3.0	--	--	< 20	--	--	< 20

All results expressed as parts per billion (ppb), unless otherwise noted.
-- = Not reported
DUP (F) = Field Duplicate
PZ-114-AS = Piezometer-114-Alluvial Shallow
Selenium (MCL: 50 ppb) was only detected in Feb. 1996 MW-101 Filtered (38 ppb).
Mercury (USEPA Method SW846-7470, MCL: 2.0 ppb) was only detected in November 1995 D-14 Unfiltered (0.21 ppb).
The groundwater samples were additionally analyzed for Total Cyanide (USEPA Method SW846-9010, MCL: 200 ppb) but was not detected.

Table C-13 : Groundwater Analytical Results - Total Petroleum Hydrocarbons

Monitoring Well Number	Diesel Range		Motor Oil Range	
	November 1995	February 1996	November 1995	February 1996
	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)
Shallow Depth Wells				
S-1	< 0.50	< 0.50	< 0.50	< 0.50
S-1 DUP (F)	--	< 0.50	--	< 0.50
S-5	**3.5**	**1.9**	< 2.5	**1.9**
S-8	< 0.50	< 0.50	< 0.50	< 0.50
S-10	**0.59**	< 0.50	< 0.50	< 0.50
S-61	< 0.50	< 0.50	< 0.50	< 0.50
S-80	< 0.50	< 0.50	< 0.50	< 0.50
S-82	< 0.50	< 0.50	< 0.50	< 0.50
S-84	< 0.50	< 0.50	< 0.50	< 0.50
S-84 DUP (F)	< 0.50	--	< 0.50	--
MW-101	< 0.50	< 0.50	< 0.50	< 0.50
MW-107	< 0.50	< 0.50	< 0.50	< 0.50
MW-F3	< 0.50	< 0.50	< 0.50	< 0.50
PZ-114-AS	< 0.50	< 0.50	< 0.50	< 0.50
Intermediate Depth Wells				
I-2	< 0.50	< 0.50	< 0.50	< 0.50
I-4	< 0.50	< 0.50	< 0.50	< 0.50
I-4 DUP (F)	< 0.50	--	< 0.50	--
I-7	< 0.50	< 0.50	< 0.50	< 0.50
I-9	< 0.50	< 0.50	< 0.50	< 0.50
I-11	< 0.50	< 0.50	**2.3**	< 0.50
I-62	< 0.50	< 0.50	< 0.50	< 0.50
I-65	< 0.50	< 0.50	**0.76**	< 0.50
I-66	< 0.50	< 0.50	< 0.50	< 0.50
I-66 DUP (F)	--	< 0.50	--	< 0.50
I-67	< 0.50	< 0.50	< 0.50	< 0.50
I-68	< 0.50	< 0.50	< 0.50	< 0.50
Deep Depth Wells				
D-3	< 0.50	< 0.50	< 0.50	< 0.50
D-6	< 0.50	< 0.50	< 0.50	< 0.50
D-12	< 0.50	< 0.50	< 0.50	< 0.50
D-13	< 0.50	< 0.50	< 0.50	< 0.50
D-14	**0.70**	**0.53**	< 0.50	< 0.50
D-83	< 0.50	< 0.50	< 0.50	< 0.50
D-85	< 0.50	< 0.50	< 0.50	< 0.50
D-85 DUP (F)	< 0.50	--	**0.65**	--
D-93	< 0.50	< 0.50	< 0.50	< 0.50
D-93 DUP (F)	--	< 0.50	--	< 0.50

All results expressed as parts per million (ppm), unless otherwise noted.
-- = Not reported
DUP (F) = Field Duplicate
PZ-114-AS = Piezometer-114-Alluvial Shallow

Table C-14 : Groundwater Analytical Results - Volatile Organic Compounds

Monitoring Well Number	Benzene		Chlorobenzene		1,4-Dichlorobenzene		cis-1,2-Dichloroethene		Acetone	
	November 1995	February 1996	November 1995	February 1996	November 1995	February 1996	November 1995	February 1996	November 1995	February 1996
	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)
Shallow Depth Wells										
S-1	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	25	< 25
S-1 DUP (F)	--	< 5.0	--	< 5.0	--	< 5.0	--	< 5.0	--	< 25
S-5	< 5.0	< 5.0	< 5.0	< 5.0	**12**	**13**	< 5.0	< 5.0	< 25	< 25
S-8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
S-10	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	**15**	**14**	< 25	< 25
S-61	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
S-80	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
S-82	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	**26**	**34**	< 25	< 25
S-84	< 5.0	< 5.0	**6.0**	**9.6**	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
S-84 DUP (F)	< 5.0	--	**5.3**	--	< 5.0	--	< 5.0	--	< 25	--
MW-101	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
MW-107	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
MW-F3	< 5.0	< 5.0	**58**	**43**	**12**	**9.9**	< 5.0	< 5.0	< 25	< 25
PZ-114-AS	< 5.0	< 5.0	**15**	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
Intermediate Depth Wells										
I-2	**11**	**5.6**	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
I-4	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
I-4 DUP (F)	< 5.0	--	< 5.0	--	< 5.0	--	< 5.0	--	< 25	--
I-7	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
I-9	**9.3**	**7.4**	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
I-11	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	**44**	< 25
I-62	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
I-65	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
I-66	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
I-66 DUP (F)	--	< 5.0	--	< 5.0	--	< 5.0	--	< 5.0	--	< 25
I-67	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
I-68	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
Deep Depth Wells										
D-3	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
D-6	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
D-12	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	**68**	< 25
D-13	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	**37**	< 25
D-14	< 5.0	< 5.0	**170**	**150**	**50**	**46**	**7.2**	**8.6**	< 25	< 25
D-83	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
D-85	< 5.0	< 5.0	< 5.0	**16**	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
D-85 DUP (F)	< 5.0	--	< 5.0	--	< 5.0	--	< 5.0	--	< 25	--
D-93	< 5.0	**5.8**	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 25	< 25
D-93 DUP (F)	--	**6.0**	--	< 5.0	--	< 5.0	--	< 5.0	--	< 25

All results expressed as parts per billion (ppb), unless otherwise noted.
-- = Not reported
DUP (F) = Field Duplicate
PZ-114-AS = Piezometer-114-Alluvial Shallow
Toluene (MCL: 1,000 ppb) was only detected in Nov. 1995 S-5 (19 ppb) and Feb. 1996 S-5 (45 ppb).
Ethyl Benzene (MCL: 700 ppb) was only detected in Nov. 1995 S-5 (13 ppb), Feb. 1996 S-5 (22 ppb), and Nov. 1995 D-14 (14 ppb).
m & p Xylene (MCL (total): 10,000 ppb) was only detected in Nov. 1995 S-5 (56 ppb), Feb. 1996 S-5 (60 ppb), and Nov. 1995 D-14 (14 ppb).
o-Xylene (MCL (total): 10,000 ppb) was only detected in Nov. 1995 S-5 (14 ppb), Feb. 1996 S-5 (18 ppb), and Nov. 1995 D-14 (5.5 ppb).
1,2-Dichlorobenzene (MCL: 600 ppb) was only detected in Nov. 1995 S-5 (5.1 ppb), Nov. 1995 MW-F3 (8.1 ppb), and Feb. 1996 MW-F3 (5.6 ppb).
1,1-Dichloroethane (MCL: NE) was only detected in Nov. 1995 D-13 (7.6 ppb) and Feb. 1996 D-13 (8.0 ppb).
2-Butanone (MCL: NE) was only detected in Nov. 1995 D-12 (70 ppb).

Table C-15 : Groundwater Analytical Results - Semivolatile Organic Compounds

Monitoring Well Number	1,4-Dichlorobenzene		4-Methylphenol		Di-n-octylphthalate		Bis(2-Ethylhexyl)phthalate	
	November 1995	February 1996	November 1995	February 1996	November 1995	February 1996	November 1995	February 1996
	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)
Shallow Depth Wells								
S-1	< 10	< 10	< 10	< 10	< 10	10	< 10	< 10
S-1 DUP (F)	--	< 10	--	< 10	--	< 10	--	< 10
S-5	< 30	< 10	< 30	< 10	< 30	< 10	< 30	< 10
S-8	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
S-10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
S-61	< 10	< 10	< 10	< 10	< 10	10	< 10	< 10
S-80	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
S-82	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
S-84	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
S-84 DUP (F)	< 10	--	< 10	--	< 10	--	< 10	--
MW-101	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
MW-107	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
MW-F3	**12**	< 10	< 10	< 10	< 10	< 10	< 10	< 10
PZ-114-AS	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Intermediate Depth Wells								
I-2	< 10	< 20	< 10	< 20	< 10	< 20	< 10	< 20
I-4	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
I-4 DUP (F)	< 10	--	< 10	--	< 10	--	< 10	--
I-7	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
I-9	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
I-11	< 10	< 10	**290**	< 10	< 10	< 10	< 10	< 10
I-62	< 10	< 10	< 10	< 10	**13**	< 10	< 10	< 10
I-65	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
I-66	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
I-66 DUP (F)	--	< 10	--	< 10	--	< 10	--	< 10
I-67	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
I-68	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Deep Depth Wells								
D-3	< 10	< 10	< 10	< 10	< 10	< 10	**17**	< 10
D-6	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
D-12	< 10	< 10	**67**	< 10	< 10	< 10	< 10	< 10
D-13	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
D-14	**18**	**38**	< 10	< 10	< 10	< 10	**16**	< 10
D-83	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
D-85	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
D-85 DUP (F)	< 10	--	< 10	--	< 10	--	< 10	--
D-93	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
D-93 DUP (F)	--	< 10	--	< 10	--	< 10	--	< 10

All results expressed as parts per billion (ppb), unless otherwise noted.
-- = Not reported
DUP (F) = Field Duplicate
PZ-114-AS = Piezometer-114-Alluvial Shallow

Table C-16 : Groundwater Analytical Results - Pesticides and Polychlorinated Biphenyls

Monitoring Well Number	4,4'-DDD		Aldrin		gamma-BHC (Lindane)	
	November 1995	February 1996	November 1995	February 1996	November 1995	February 1996
	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)
Shallow Depth Wells						
S-1	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
S-1 DUP (F)	--	< 0.02	--	< 0.01	--	< 0.01
S-5	**0.11**	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
S-8	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
S-10	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
S-61	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
S-80	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
S-82	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
S-84	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
S-84 DUP (F)	< 0.02	--	< 0.01	--	< 0.01	--
MW-101	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
MW-107	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
MW-F3	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
PZ-114-AS	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Intermediate Depth Wells						
I-2	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
I-4	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
I-4 DUP (F)	< 0.02	--	< 0.01	--	< 0.01	--
I-7	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
I-9	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
I-11	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
I-62	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
I-65	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
I-66	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
I-66 DUP (F)	--	< 0.02	--	< 0.01	--	< 0.01
I-67	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
I-68	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
Deep Depth Wells						
D-3	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
D-6	< 0.02	< 0.02	**0.02**	< 0.01	< 0.01	< 0.01
D-12	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
D-13	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
D-14	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
D-83	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
D-85	< 0.02	< 0.02	< 0.01	< 0.01	**0.011**	< 0.01
D-85 DUP (F)	< 0.02	--	< 0.01	--	< 0.01	--
D-93	< 0.02	< 0.02	< 0.01	< 0.01	< 0.01	< 0.01
D-93 DUP (F)	--	< 0.02	--	< 0.01	--	< 0.01

All results expressed as parts per billion (ppb), unless otherwise noted.
-- = Not reported
DUP (F) = Field Duplicate
PZ-114-AS = Piezometer-114-Alluvial Shallow
No Polychlorinated Biphenyl Aroclors were detected.

Table C-17 : Perched Water Analytical Results - Uranium-238, Uranium-235, and Thorium-232 Decay Series

Boring	Depth	Uranium-238			Thorium-234			Uranium-234			Thorium-230			Radium-226			Lead-214			Bismuth-214			Lead-210		
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
AREA 1																									
WL-108	22	**0.35**		0.30	MDA	--		MDA	--	0.33	**0.59**		0.072	MDA	--	38.2	MDA	--		MDA	--		MDA	--	1100
AREA 2																									
WL-219	25	**0.39**		0.15	**133 ***		104	**0.35**		0.18	**0.15**		0.047	MDA	--	28.9	MDA	--		MDA	--		MDA	--	181
WL-220	30	MDA	--	0.16	MDA	--		**0.19**		0.17	**1.72**		0.15	MDA	--	28.3	MDA	--		MDA	--		MDA	--	139
WL-231	31	MDA	--	0.62	MDA	-		**0.97**		0.49	**3.70**		1.93	MDA	--	27.7	MDA	--		MDA	--		MDA	--	181
LEACHATE SEEP																									
Leachate Seep		**0.54**		0.18	--	--	--	**0.94**		0.28	**0.85**		0.4	**0.83**		0.83	--	--	--	--	--	--	--	--	--
Leachate Seep Dup (F)		**0.75**		0.24	--	--	--	**0.98**		0.24	MDA	--	0.62	MDA	--	0.69	--	--	--	--	--	--	--	--	--

* Combined Maximum Contaminant Level for Radium-226 and Radium-228

Boring	Depth	Uranium-235/236			Uranium-235			Protactinium-231			Actinium-227			Radium-223		
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
AREA 1																
WL-108	22	MDA	--	0.34	MDA	--		MDA	--	453	MDA	--	91.6	MDA	--	
AREA 2																
WL-219	25	MDA	--	0.18	MDA	--		MDA	--	292	MDA	--	61.8	MDA	--	
WL-220	30	MDA	--	0.22	MDA	--		MDA	--	298	MDA	--	55.3	MDA	--	
WL-231	31	MDA	--	0.72	MDA	--		MDA	--	302	MDA	--	60.6	MDA	--	
LEACHATE SEEP																
Leachate Seep		MDA	--	0.225	--	--	--	--	--	--	--	--	--	--	--	--
Leachate Seep Dup (F)		MDA	--	0.300	--	--	--	--	--	--	--	--	--	--	--	--

Boring	Depth	Thorium-232			Radium-228			Thorium-228			Radium-224			Lead-212			Thallium-208		
	(feet)	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA	Result	+/- Sigma	MDA
AREA 1																			
WL-108	22	MDA	--	0.040	MDA	--		MDA	--	0.099	MDA	--		MDA	--		MDA	--	
AREA 2																			
WL-219	25	**0.042**		0.024	MDA	--		**0.12**		0.050	MDA	--		MDA	--		MDA	--	
WL-220	30	MDA	--	0.09	MDA	--		MDA	--	0.16	MDA	--		MDA	--		MDA	--	
WL-231	31	MDA	--	1.76	MDA	--		MDA	--	1.44	MDA	--		MDA	--		MDA	--	
LEACHATE SEEP																			
Leachate Seep		MDA	--	0.38	--	--	--	MDA	--	0.60	--	--	--	--	--	--	--	--	--
Leachate Seep Dup (F)		MDA	--	0.52	--	--	--	MDA	--	0.63	--	--	--	--	--	--	--	--	--

-- = Not reported

DUP (L) = Laboratory duplicate

MCL = Maximum Contaminant Level (Missouri Department of Natural Resources Drinking Water Program, October 1994)

DUP (F) = Field duplicate

MDA = Minimum Detectable Activity

* = Analytical result is a false positive. The half-life of thorium-234 is 24 days and therefore thorium-234 should be in secular equilibrium with uranium-238. Review of parent and daughter products of thorium-234 indicate that secular equilibrium conditions exist and that the thorium-234 concentration should approximate 0.35 to 0.39 pCi/l

Bolded numbers indicate result above the Minimum Detectable Activity

Appendix D :

Radiological and Non-Radiological Analytical Results For Surface Water Samples

Table D-1 : Rainwater Runoff, Leachate, and Surface Water Analytical Results - Uranium-238 Decay Series

		Uranium-238						Thorium-234						Uranium-234						Thorium-230					
		Unfiltered			Filtered			Unfiltered			Filtered			Unfiltered			Filtered			Unfiltered			Filtered		
	Sample Date	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error
Rainwater Runoff																									
Area 1																									
Weir 1	5/18-19/95	**1.47**	0.27	0.67	**1.59**	0.12	0.51	--	--	--	--	--	--	--	--	--	--	--	.	**0.26**	0.34	0.31	**0.33**	0.13	0.22
Weir 2	5/18-19/95	**3.66**	0.11	0.88	**3.60**	0.07	0.88	--	--	--	--	--	--	--	--	--	--	--	--	**0.85**	0.16	0.34	**0.32**	0.16	0.22
Weir 3	5/18-19/95	**2.84**	0.08	0.78	**2.86**	0.08	0.78	--	--	--	--	--	--	.	.	--	--	--		**0.17**	0.15	0.12	MDA	0.11	--
Weir 3	8/19/97	**0.93**	0.039	0.23	**1.18**	0.087	0.26	--	--	--	--	--	--	**0.85**	0.059	0.22	**0.94**	0.088	0.23	**0.57**	0.10	0.17	**1.11**	0.065	0.25
Weir 4	5/18-19/95	**0.45**	0.12	0.24	**0.36**	0.14	0.20	--	--	--	.	--	--	--	.	--	--	--	--	**0.28**	0.10	0.21	**0.19**	0.19	0.15
Weir 4	8/19/97	**0.11**	0.10	0.09	**0.12**	0.037	0.08	--	--	--	.	--	--	**0.22**	0.074	0.12	**0.18**	0.073	0.10	**0.53**	0.10	0.16	**0.47**	0.068	0.16
Weir 4 (DUP)	8/19/97	**0.091**	0.05	0.083	MDA	0.10	--	--	--	--	.	--	--	**0.23**	0.12	0.14	**0.22**	0.10	0.13	**0.68**	0.13	0.19	**0.35**	0.088	0.13
Area 2																									
Weir 5	4/29/96	**45.8**	0.4	10.9	**49.6**	0.3	11.6	MDA	130.9	--	MDA	171.8	--	**49.6**	0.4	11.8	**41.4**	0.4	9.7	**13.1**	0.3	3.5	**2.81**	0.20	0.68
Weir 5	8/19/97	**14.3**	0.097	2.3	**14.0**	0.050	1.7	--	--	--	--	--	--	**14.2**	0.050	2.3	**13.5**	0.051	1.7	**9.81**	0.1	1.6	**2.41**	0.11	0.48
Weir 7	4/29/96	**4.20**	0.11	1.07	**5.86**	0.09	1.35	MDA	158.2	--	MDA	144.8	--	**6.26**	0.07	1.5	**6.22**	0.09	1.42	**1.88**	0.53	0.82	MDA	1.62	--
Weir 8	4/29/96	MDA	4.23	--	**0.27**	0.15	0.17	MDA	299.1	--	MDA	137.9	--	MDA	6.73	--	**0.43**	0.15	0.22	**5.27**	0.21	1.24	**0.57**	0.15	0.25
Weir 8	8/19/97	**3.57**	0.05	0.54	**1.32**	0.054	0.24	--	--	--	--	.	--	**3.47**	0.050	0.53	**1.38**	0.044	0.25	**29.5**	0.21	4.30	**2.15**	0.15	0.56
Weir 9	4/29/96	**5.64**	0.33	1.57	**5.22**	0.18	1.18	**175**	103	106	MDA	140.0	--	**6.07**	0.28	1.66	**5.26**	0.18	1.19	**204**	0.2	42	**2.02**	0.30	0.59
Weir 9	8/19/97	**0.47**	0.071	0.16	**0.63**	0.14	0.25	--	--	--	--	--	--	**0.63**	0.088	0.19	**0.69**	0.15	0.27	**5.25**	0.13	0.86	**1.78**	0.076	0.41
Weir 10	8/19/97	**1.97**	0.15	0.56	**2.66**	0.077	0.46	--	--	--	--	--	--	**2.20**	0.18	0.61	**3.20**	0.083	0.53	**7.14**	0.086	1.24	**0.69**	0.13	0.23
Area 2 Leachate Seep																									
Leachate Seep		**0.59**	0.21	0.36	**0.54**	0.18	0.39	--	--	--	--	--	--	**0.84**	0.24	0.44	**0.94**	0.28	0.53	**0.92**	0.42	0.61	**0.85**	0.40	0.57
Leachate Seep DUP (F)		**0.49**	0.15	0.32	**0.75**	0.24	0.44	--	--	--	--	--	.	**1.14**	0.15	0.52	**0.98**	0.24	0.24	**0.66**	0.28	0.49	MDA	0.62	--
Surface Water																									
Surface Water N of Area 2 (SW-2)	11/95	MDA	1.46	--	**0.32**	0.20	0.24	MDA	280.2	--	**154**	140	140	**3.11**	1.57	2.18	**0.44**	0.22	0.29	**2.93**	0.11	0.58	**11.9**	0.2	2.5
SW-2	5/97	**0.81**	0.05	0.23	**0.63**	0.15	0.27	**1.08**	0.05	0.28	—	--	--	—	--	--	**1.32**	0.17	0.42	**0.22**	0.04	0.08	**0.25**	0.079	0.12
SW-2 DUP (L)	5/97	--	--	--	**1.06**	0.12	0.34	--	--	--	—	--	--	—	--	--	**1.39**	0.16	0.41	—	--	--	**0.51**	0.12	0.2
Surface Water S of Area 2 (SW-1)	11/95	**0.79**	0.19	0.40	**1.07**	0.19	0.47	MDA	224.0	--	MDA	156.0	--	**0.95**	0.21	0.45	**1.22**	0.24	0.52	**1.15**		0.39	**1.26**	0.22	0.39
SW-1	5/97	**0.91**	0.08	0.26	**1.28**	0.12	0.4	**1.28**	0.08	0.33	**1.44**	0.12	0.43	--	--	--	—	--	.	**0.22**	0.05	0.08	**0.16**	0.07	0.08
SW-1 DUP (F)	5/97	**0.99**	0.12	0.3	—	--	--	**1.29**	0.13	0.36	—	--	--	--	--	.	--	--	--	**0.36**	0.062	0.12	—	--	.

		Radium-226						Lead-214						Bismuth-214						Lead-210					
		Unfiltered			Filtered			Unfiltered			Filtered			Unfiltered			Filtered			Unfiltered			Filtered		
	Sample Date	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error
Rainwater Runoff																									
Area 1																									
Weir 1	5/18-19/95	MDA	0.28	0.32	**0.33**	0.32	0.25	--	--	--	--	--	--	--	--	.	--	--	--	--	--	--	--	--	--
Weir 2	5/18-19/95	**0.52**	0.46	0.35	**0.51**	0.37	0.32	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	.
Weir 3	5/18-19/95	**0.77**	0.46	0.38	MDA	0.52	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 3	8/19/97	**0.23**	0.17	0.13	**0.30**	0.12	0.13	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 4	5/18-19/95	MDA	0.50	--	MDA	0.37	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 4	8/19/97	**0.19**	0.18	0.13	MDA	0.16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 4 (DUP)	8/19/97	**0.17**	0.13	0.10	MDA	0.16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Area 2																									
Weir 5	4/29/96	**2.60**	0.30	0.45	**1.12**	0.18	0.26	MDA	22.69	--	MDA	25.37	--	MDA	26.52	--	MDA	29.93	--	MDA	107	--	MDA	214	--
Weir 5	8/19/97	**1.27**	0.15	0.27	**0.68**	0.24	0.22	--	--	--	--	.	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 7	4/29/96	**0.68**	0.23	0.22	**0.50**	0.19	0.19	MDA	28.71	--	MDA	23.12	--	MDA	30.63	--	MDA	28.08	--	MDA	197	--	MDA	163	--
Weir 8	4/29/96	MDA	0.28	--	**0.31**	0.25	0.19	MDA	33.22	--	MDA	20.64	--	MDA	33.81	--	MDA	28.18	--	**9200**	1930	5560	MDA	112	--
Weir 8	8/19/97	**1.68**	0.20	0.33	**0.34**	0.14	0.14	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 9	4/29/96	**8.85**	0.29	1.10	**0.80**	0.28	0.27	MDA	24.87	--	MDA	22.06	--	MDA	27.19	--	MDA	25.16	--	MDA	207	--	MDA	151	--
Weir 9	8/19/97	**0.32**	0.15	0.14	**0.24**	0.23	0.16	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 10	8/19/97	**0.44**	0.14	0.16	MDA	0.14	--	--	--	--	--	--	--	.	--	--	--	--	--	--	--	--	--	--	--
Area 2 Leachate Seep																									
Leachate Seep		MDA	0.66	--	**0.83**	0.83	0.58	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Leachate Seep DUP (F)		MDA	0.73	--	MDA	0.69	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Surface Water																									
Surface Water N of Area 2 (SW-2)	11/95	MDA	0.14	--	**0.11**	0.09	0.06	MDA	33.18	--	MDA	21.38	--	MDA	37.46	--	MDA	25.37	--	MDA	2730	.	MDA	306	--
SW-2	5/97	**0.24**	0.1	0.08	**0.23**	0.19	0.12	MDA	34.6	--	MDA	33.8	--	MDA	34.6	-	MDA	28.4	--	MDA	208	--	MDA	414	--
SW-2 DUP (L)	5/97	--	--	--	**0.36**	0.13	0.10	--	--	--	MDA	26.5	--	--	.	--	MDA	34.6	--	--	--	.	MDA	259	.
Surface Water S of Area 2 (SW-1)	11/95	MDA	0.21	--	MDA	0.08	--	MDA	24.40	--	MDA	24.89	--	MDA	24.01	--	MDA	26.47	--	MDA	1320	--	MDA	144	--
SW-1	5/97	**0.36**	0.08	0.08	**0.7**	0.06	0.10	MDA	24.2	--	MDA	28.3	--	MDA	35.2	--	MDA	32	--	MDA	221	--	MDA	150000	--
SW-1 DUP (F)	5/97	**0.67**	0.05	0.10	--	--	--	MDA	26.4	--	--	-	--	MDA	32.9	--	—	--	--	MDA	224	--	—	--	--

All values expressed as pCi/L unless otherwise indicated

-- = Not reported. In accordance with the Work Plan, Area 1 rainwater and the leachate seep were not analyzed by EPA 901.1. However, Area 2 rainwater EPA 901.1 results were provided by the laboratory

DUP (F) = Field duplicate

MDA = Minimum Detectable Activity

Bolded numbers indicate result above minimum detectable activity

Table D-2 : Rainwater Runoff, Leachate, and Surface Water Analytical Results - Uranium-235 Decay Series

		Uranium-235/236						Uranium-235						Protactinium-231						Actinium-227						Radium-223					
		Unfiltered			Filtered			Unfiltered			Filtered			Unfiltered			Filtered			Unfiltered			Filtered			Unfiltered			Filtered		
	Sample Date	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error
Rainwater Runoff																															
Area 1																															
Weir 1	5/18-19/95	< MDA	0.216	--	< MDA	0.144	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 2	5/18-19/95	**0.44**	0.15	0.25	**0.26**	0.09	0.19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 3	5/18-19/95	< MDA	0.19	--	**0.26**	0.15	0.20	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 3	8/19/97	**0.12**	0.037	0.08	**0.064**	0.035	0.058	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 4	5/18-19/95	< MDA	0.095	--	< MDA	0.182	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 4	8/19/97	< MDA	0.12	--	< MDA	0.12	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 4 (DUP)	8/19/97	< MDA	0.15	--	< MDA	0.056	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Area 2																															
Weir 5	4/29/96	**4.27**	0.43	1.36	**6.84**	0.37	1.94	< MDA	43	--	< MDA	53	--	< MDA	264	--	< MDA	305	--	< MDA	42.0	--	< MDA	60.9	--	< MDA	371	--	< MDA	522	--
Weir 5	8/19/97	**0.43**	0.062	0.21	**0.59**	0.075	0.18	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 7	4/29/96	**0.69**	0.09	0.33	**0.71**	0.07	0.31	< MDA	51	--	< MDA	48	--	< MDA	368	--	< MDA	273	--	< MDA	56.4	--	< MDA	52.1	--	< MDA	581	--	< MDA	447	--
Weir 8	4/29/96	< MDA	6.18	--	< MDA	0.18	--	< MDA	107	--	< MDA	41	--	< MDA	468	--	< MDA	264	--	< MDA	98.9	--	< MDA	45.2	--	< MDA	751	--	< MDA	412	--
Weir 8	8/19/97	**0.13**	0.032	0.08	**0.073**	0.072	0.056	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 9	4/29/96	**1.18**	0.46	0.56	**0.23**	0.19	0.17	< MDA	60	--	< MDA	52	--	< MDA	348	--	< MDA	316	--	< MDA	56.6	--	< MDA	55.2	--	< MDA	497	--	< MDA	443	--
Weir 9	8/19/97	< MDA	0.088	--	< MDA	0.19	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 10	8/19/97	**0.23**	0.18	0.19	**0.16**	0.19	0.15	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Area 2 Leachate Seep																															
Leachate Seep		< MDA	0.257	--	< MDA	0.225	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Leachate Seep DUP (F)		< MDA	0.26	--	< MDA	0.300	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Surface Water																															
Surface Water N of Area 2 (SW-2)	11/95	< MDA	2.02	--	< MDA	0.31	--	< MDA	98	--	< MDA	65	--	< MDA	477	--	< MDA	288	--	< MDA	95.1	--	< MDA	65	--	< MDA	835	--	< MDA	516	--
SW-2	5/97	**0.12**	0.08	0.08	**0.14**	0.06	0.13	--	--	--	--	--	--	< MDA	276	--	< MDA	358	--	< MDA	73.2	--	< MDA	81	--	< MDA	121	--	< MDA	194	--
SW-2 DUP (L)	5/97	--	--	--	**0.06**	0.16	0.09	--	--	--	--	--	--	--	--	--	< MDA	336	--	--	--	--	< MDA	73.1	--	--	--	--	< MDA	107	--
Surface Water S of Area 2 (SW-1)	11/95	< MDA	0.21	--	< MDA	0.22	--	< MDA	64	--	< MDA	53	--	< MDA	339	--	< MDA	362	--	< MDA	69.4	--	< MDA	58.8	--	< MDA	608	--	< MDA	524	--
SW-1	5/97	**0.07**	0.1	0.07	**0.25**	0.14	0.17	--	--	--	--	--	--	< MDA	309	--	< MDA	422	--	< MDA	63.3	--	< MDA	79.4	--	< MDA	112	--	< MDA	416	--
SW-1 DUP (F)	5/97	**0.13**	0.12	0.11	--	--	--	--	--	--	--	--	--	< MDA	351	--	--	--	--	< MDA	69.4	--	--	--	--	< MDA	125	--	--	--	--

All values expressed as pCi/L, unless otherwise indicated.

-- = Not reported. In accordance with the Work Plan, Area 1 rainwater and the leachate seep were not analyzed by EPA 901.1. However, Area 2 rainwater EPA 901.1 results were provided by the laboratory.

DUP (F) = Field duplicate

MDA = Minimum Detectable Activity

Bolded numbers indicate result above minimum detectable activity

Table D-3 : Rainwater Runoff, Leachate, and Surface Water Analytical Results - Thorium-232 Decay Series

		Thorium-232						Radium-228						Thorium 228					
		Unfiltered			Filtered			Unfiltered			Filtered			Unfiltered			Filtered		
	Sample Date	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error
Rainwater Runoff																			
Area 1																			
Weir 1	5/18-19/95	< MDA	0.236	--	< MDA	0.091	--	--	--	--	--	--	--	< MDA	0.545	--	< MDA	0.234	--
Weir 2	5/18-19/95	< MDA	0.132	--	< MDA	0.158	--	--	--	--	--	--	--	< MDA	0.222	--	< MDA	0.258	--
Weir 3	5/18-19/95	< MDA	0.081	--	< MDA	0.079	--	--	--	--	--	--	--	< MDA	0.18	--	< MDA	0.156	--
Weir 3	8/19/97	< MDA	0.064	--	< MDA	0.065	--	< MDA	0.87	--	< MDA	0.81	--	< MDA	0.11	--	< MDA	0.094	--
Weir 4	5/18-19/95	< MDA	0.096	--	< MDA	0.205	--	--	--	--	--	--	--	< MDA	0.190	--	< MDA	0.223	--
Weir 4	8/19/97	< MDA	0.059	--	**0.032**	0.029	0.038	< MDA	0.80	--	< MDA	0.98	--	< MDA	0.097	--	< MDA	0.11	--
Weir 4 (DUP)	8/19/97	< MDA	0.18	--	< MDA	0.051	--	< MDA	0.86	--	< MDA	0.91	--	< MDA	0.130	--	< MDA	0.12	--
Area 2																			
Weir 5	4/29/96	**1.11**	0.24	0.52	< MDA	0.16	--	< MDA	42.01	--	< MDA	48.86	--	**1.16**	0.34	0.55	**0.97**	0.15	0.31
Weir 5	8/19/97	**0.25**	0.063	0.12	**0.088**	0.075	0.069	< MDA	0.87		**1.7**	0.72	0.32	< MDA	0.086	--	< MDA	0.13	--
Weir 7	4/29/96	< MDA	0.35	--	< MDA	1.28	--	< MDA	52.35	--	< MDA	40.20	--	**0.66**	0.33	0.42	**2.12**	1.28	1.99
Weir 8	4/29/96	**1.87**	0.20	0.54	< MDA	0.10	--	< MDA	59.13	--	< MDA	41.13	--	**2.55**	0.24	0.69	**0.84**	0.12	0.28
Weir 8	8/19/97	**0.57**	0.14	0.19	**0.063**	0.06	0.074	< MDA	0.94		**1.94**	0.74	0.31	< MDA	0.120	--	< MDA	0.18	--
Weir 9	4/29/96	**4.25**	0.19	1.08	**0.45**	0.26	0.23	< MDA	55.87	--	< MDA	48.19	--	**1.46**	0.19	0.48	**0.78**	0.22	0.31
Weir 9	8/19/97	< MDA	0.09	--	< MDA	0.10	--	< MDA	0.87		**1.37**	0.76	0.31	< MDA	0.12	--	< MDA	0.13	--
Weir 10	8/19/97	**0.48**	0.071	0.18	< MDA	0.038	--	< MDA	0.93		**1.57**	0.77	0.33	**0.32**			< MDA	0.16	--
Area 2 Leachate Seep																			
Leachate Seep		< MDA	0.37	--	< MDA	0.375	--	--	--	--	--	--	--	< MDA	0.650	--	< MDA	0.598	--
Leachate Seep DUP (F)		< MDA	0.310	--	< MDA	0.52	--	--	--	--	--	--	--	< MDA	0.636	--	< MDA	0.629	--
Surface Water																			
Surface Water N of Area 2 (SW-2)	11/95	**0.09**	0.06	0.06	**1.14**	0.14	0.39	< MDA	63.42	--	< MDA	38.16	--	< MDA	0.060	--	< MDA	0.16	--
SW-2	5/97	< MDA	0.037	0.028	< MDA	0.079	0.047	< MDA	0.85	0.52	< MDA	1.31	0.75	< MDA	0.048	0.035	< MDA	0.12	0.056
SW-2 DUP (L)	5/97	--	--	--	< MDA	0.094	0.011	--	--	--	< MDA	1.19	0.72	--	--	--	< MDA	0.17	0.056
Surface Water S of Area 2 (SW-1)	11/95	**0.93**	0.12	0.32	**0.14**	0.14	0.11	< MDA	40.52	--	< MDA	51.02	--	**0.16**	0.12	0.12	< MDA	0.17	--
SW-1	5/97	**0.11**	0.044	0.06	< MDA	0.082	0.033	**0.61**	0.74	0.45	**0.63**	0.57	0.36	**0.085**	0.055	0.051	< MDA	0.084	0.041
SW-1 DUP (F)	5/97	**0.056**	0.051	0.043	--	--	--	**0.34**			--	--	--	< MDA	0.08	0.051	--	--	--

		Radium-224						Lead-212						Thallium-208					
		Unfiltered			Filtered			Unfiltered			Filtered			Unfiltered			Filtered		
	Sample Date	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error
Rainwater Runoff																			
Area 1																			
Weir 1	5/18-19/95	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 2	5/18-19/95	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 3	5/18-19/95	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 3	8/19/97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 4	5/18-19/95	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 4	8/19/97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 4 (DUP)	8/19/97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Area 2																			
Weir 5	4/29/96	< MDA	153.02	--	< MDA	194.1	--	< MDA	15.33	--	< MDA	17.71	--	< MDA	9.05	--	< MDA	14.10	--
Weir 5	8/19/97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 7	4/29/96	< MDA	182.4	--	< MDA	181.8	--	< MDA	17.72	--	< MDA	16.17	--	< MDA	14.14	--	< MDA	12.06	--
Weir 8	4/29/96	< MDA	313.2	--	< MDA	146.7	--	< MDA	26.65	--	< MDA	16.10	--	< MDA	16.47	--	< MDA	11.79	--
Weir 8	8/19/97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 9	4/29/96	< MDA	187.5	--	< MDA	174.4	--	< MDA	16.17	--	< MDA	16.35	--	< MDA	14.65	--	< MDA	14.64	--
Weir 9	8/19/97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Weir 10	8/19/97	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Area 2 Leachate Seep																			
Leachate Seep		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Leachate Seep DUP (F)		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Surface Water																			
Surface Water N of Area 2 (SW-2)	11/95	< MDA	285.3	--	< MDA	204.8	--	< MDA	25.75	--	**18.6**	15.4	12.6	< MDA	15.68	--	< MDA	12.54	--
SW-2	5/97	--	--	--	--	--	--	< MDA	20.8	--	< MDA	23	--	< MDA	16	--	< MDA	13	--
SW-2 DUP (L)	5/97	--	--	--	--	--	--	--	--	--	< MDA	23.3	--	--	--	--	< MDA	15.3	--
Surface Water S of Area 2 (SW-1)	11/95	< MDA	212.0	--	< MDA	203.4	--	< MDA	19.97	--	< MDA	18.73	--	< MDA	12.51	--	< MDA	14.35	
SW-1	5/97	--	--	--	--	--	--	< MDA	18.6	--	< MDA	23.3	--	< MDA	16.1	--	< MDA	14	--
SW-1 DUP (F)	5/97	--	--	--	--	--	--	< MDA	19.9	--	--	--	--	< MDA	14.4	--	--	--	--

All values expressed as pCi/L, unless otherwise indicated.

-- = Not reported. In accordance with the Work Plan, Area 1 rainwater and the leachate seep were not analyzed by EPA 901.1. However, Area 2 rainwater EPA 901.1 results were provided by the laboratory.

DUP (F) = Field duplicate

MDA = Minimum Detectable Activity

Bolded numbers indicate result above minimum detectable activity

Table D-4 : Rainwater Runoff, Leachate Seep, and Surface Water Analytical Results - Priority Pollutant Metals and Cyanide

	Lead		Zinc	
	Unfiltered	Filtered	Unfiltered	Filtered
	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)
Rainwater Runoff				
Area 1				
Weir 1	--	--	--	--
Weir 2	--	--	--	--
Weir 3	--	--	--	--
Weir 4	--	--	--	--
Area 2				
Weir 5	--	--	--	--
Weir 7	--	--	--	--
Weir 8	--	--	--	--
Weir 9	--	--	--	--
Area 2 Leachate Seep				
Leachate Seep	**17**	*< 3.0*	**130**	*< 20*
Surface Water				
Surface Water North of Area 2	**18**	**3.9**	*< 20*	*< 20*
Surface Water South of Area 2	*< 3.0*	*< 3.0*	*< 20*	*< 20*

< = Result reported below the reporting limit
-- = Not reported. Rainwater runoff was not analyzed for priority pollutant metals.
Bold numbers indicate result reported above the method detection limit.

Table D-5 : Rainwater Runoff, Leachate Seep, and Surface Water Analytical Results - Total Petroleum Hydrocarbons

	Diesel Range	Motor Oil Range
Rain Water Runoff	**Result (ppm)**	**Result (ppm)**
Area 1		
Weir 1	*< 0.50*	*< 0.50*
Weir 2	*< 0.50*	*< 0.50*
Weir 3	*< 0.50*	*< 0.50*
Weir 4	*< 0.50*	*< 0.50*
Area 2		
Weir 5	*< 0.50*	*< 0.50*
Weir 7	*< 0.50*	*< 0.50*
Weir 8	*< 0.50*	*< 0.50*
Weir 9	*< 0.50*	*< 0.50*
Area 2 Leachate Seep		
Leachate Seep	**0.47 J**	**0.48 J**
Surface Water		
Surface Water North of Area 2	*< 0.50*	*< 0.50*
Surface Water South of Area 2	*< 0.50*	*< 0.50*

< = Result reported below the reporting limit
J = Estimated value. Result was below the reporting limit.
Bold numbers indicate result reported above the method detection limit.

Table D-6 : Rainwater Runoff, Leachate Seep, and Surface Water Analytical Results
- Volatile Organic Compounds (parts per billion [ppb])

	Benzene	Ethyl benzene	m & p Xylene	Chlorobenzene	1,4 - Dichlorobenzene
	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)	Result (ppb)
Rainwater Runoff					
Area 1					
Weir 1	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Weir 2	< 5.0	**2.2 J**	**13**	< 5.0	< 5.0
Weir 3	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Weir 4	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Area 2					
Weir 5	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Weir 7	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Weir 8	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Weir 9	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Area 2 Leachate Seep					
Leachate Seep	**2.2 J**	< 5.0	< 5.0	**78**	**11**
Surface Water					
Surface Water North of Area 2	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Surface Water South of Area 2	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0

< = Result reported below the reporting limit
J = Estimated value. Result was below the reporting limit.
Bold numbers indicate result reported above the method detection limit.

Table D-7 : Rainwater Runoff, Leachate Seep, and Surface Water Analytical Results - Semivolatile Organic Compounds (parts per billion [ppb])

	1,4 - Dichlorobenzene	2,4-Dimethylphenol
	Result (ppb)	Result (ppb)
Rainwater Runoff		
Area 1		
Weir 1	*< 10*	*< 10*
Weir 2	*< 10*	**75**
Weir 3	*< 10*	*< 10*
Weir 4	*< 10*	*< 10*
Area 2		
Weir 5	*< 10*	*< 10*
Weir 7	*< 10*	*< 10*
Weir 8	*< 10*	*< 10*
Weir 9	*< 10*	*< 10*
Area 2 Leachate Seep		
Leachate Seep	**6.5 J**	*< 10*
Surface Water		
Surface Water North of Area 2	*< 10*	*< 10*
Surface Water South of Area 2	*< 10*	*< 10*

< = Result reported less than the reporting limit
J = Estimated value. Result was below the reporting limit.
Bold numbers indicate result reported above the method detection limit.

Table D-8 : Rainwater Runoff, Leachate Seep, and Surface Water Analytical Results
- Leachate Indicator Parameters

	pH	TDS	TSS	Chloride	Nitrate-N	Total Phosphate	COD	TOC	Ammonia
	Result	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)
Rainwater Runoff									
Area 1									
Weir 1	--	--	*< 5.0*	--	--	--	--	--	--
Weir 2	--	--	**7.5**	--	--	--	--	--	--
Weir 3	--	--	*< 5.0*	--	--	--	--	--	--
Weir 4	--	--	*< 5.0*	--	--	--	--	--	--
Area 2									
Weir 5	--	--	*< 5.0*	--	--	--	--	--	--
Weir 7	--	--	**6.2**	--	--	--	--	--	--
Weir 8	--	--	**830**	--	--	--	--	--	--
Weir 9	--	--	**44**	--	--	--	--	--	--
Area 2 Leachate Seep									
Leachate Seep	**6.8**	**2000**	**42**	**51**	**0.030**	**0.45**	**140**	**73**	**7.7**
Leachate Seep DUP (L)	--	**2100**	--	--	--	--	--	--	--
Surface Water									
Surface Water North of Area 2	--	--	--	--	--	--	--	--	--
Surface Water South of Area 2	--	--	--	--	--	--	--	--	--

< = Result reported below the reporting limit
-- = Not reported. In accordance with the Work Plan, rainwater runoff and surface water were not analyzed for many of the leachate parameters.
DUP (L) = Laboratory duplicate. Duplicate analyses were only performed for Total Dissolved Solids on the Leachate Seep sample.
TDS = Total Dissolved Solids
TSS = Total Suspended Solids
COD = Chemical Oxygen Demand
TOC = Total Organic Carbon
Total Cyanide (USEPA Method 9010) was additionally analyzed for the rainwater runoff, leachate seep, and surface water samples but was not detected.
The leachate seep was additionally analyzed for Nitrite (USEPA Method 353.3), Sulfide (USEPA Method 376.1), and Biochemical Oxygen Demand (USEPA Method 405.1).
None of these parameters were detected.
Bold numbers indicate result reported above the method detection limit.

Appendix E :

Radiological and Non-Radiological Analytical Results For Sediment Samples

Table E-1 : Erosional Sediment Analytical Results - Uranium-238 Decay Series

Sample Location	Sample Date	Uranium-238			Thorium-234			Uranium-234			Thorium-230			Radium-226			Lead-214			Bismuth 214			Lead-210		
		Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error
Site Specific Background (Mean +2)		1.81			2.76			2.73			2.54			1.3			1.13			1.61			3.77		
Reference Level Concentration		6.81			7.76			7.73			7.54			6.3			6.13			6.61			8.77		
AREA 1																									
WEIR 1		**0.88**	0.18	0.41	< MDA	1.13	--	**1.25**	0.24	0.51	**4.00**	0.12	0.96	**0.64**	0.24	0.16	**0.63**	0.26	0.21	**0.67**	0.24	0.23	< MDA	1.72	--
WEIR 1 DUP (F)		--	--	--	< MDA	3.49	--	--	--	--	--	--	--	< MDA	0.74	--	< MDA	0.65	--	< MDA	0.74	--	< MDA	42.60	--
WEIR 1	15-May-97	**0.61**	0.08	0.18	--	--	--	**0.76**	0.08	0.21	**3.02**	0.06	0.62	**4.77**	3.6	3.96	<MDA	0.67	--	<MDA	0.82	--	<MDA	2.54	--
WEIR 2		**2.79**	0.46	0.98	< MDA	4.55	--	**2.56**	0.67	0.96	**147**	3	29	**18.8**	0.5	1.2	**19.5**	0.5	1.4	**18.8**	0.5	1.5	**33.1**	4.5	5.3
WEIR 2 DUP (F)		--	--	--	< MDA	2.22	--	--	--	--	--	--	--	**3.32**	0.35	0.34	**3.59**	0.31	0.39	**2.85**	0.35	0.49	**5.98**	2.18	1.74
WEIR 2	15-May-97	**2.15**	0.07	0.47	--	--	--	**1.77**	0.09	0.4	**215**	0.08	39	<MDA	7.43	--	**5.84**	0.56	1.03	<MDA	1.88	--	**10.6**	3.6	3.4
WEIR 3		**0.65**	0.21	0.36	< MDA	1.20	--	**0.94**	0.29	0.45	**6.36**	0.21	6.36	**0.64**	0.31	0.20	**0.63**	0.28	0.29	< MDA	0.53	--	**1.83**	1.51	1.07
WEIR 3 DUP (F)		--	--		< MDA	1.49	--	--	--	--	--	--	--	**0.71**	0.31	0.18	**0.61**	0.22	0.20	< MDA	0.58	--	**2.56**	1.11	1.42
WEIR 3	15-May-97	**1.14**	0.08	0.3	--	--	--	**1.23**	0.11	0.32	**11.6**	0.09	2.1	**5.59**	3.7	3.68	**1.1**	0.47	0.48	<MDA	1.15	--	<MDA	2.56	--
WEIR 4		**0.87**	0.21	0.41	< MDA	1.49	--	**1.04**	0.21	0.45	**1.57**	0.12	0.46	**0.66**	0.35	0.20	**0.62**	0.30	0.25	< MDA	0.58	--	< MDA	1.74	--
WEIR 4 DUP (F)		--	--		< MDA	3.37	--	--	--	--	--	--	--	**0.67**	0.30	0.18	**0.69**	0.25	0.19	< MDA	0.53	--	< MDA	26.90	--
WEIR 4	15-May-97	**0.62**	0.09	0.18	--	--	--	**0.7**	0.09	0.2	**1.46**	0.07	0.36	<MDA	5.43	--	**0.73**	0.52	0.37	<MDA	0.88	--	<MDA	3.85	--
AREA 2																									
WEIR 5		**11.4**	4.4	7.3	< MDA	8.34	--	**6.90**	5.91	5.71	**413**	0.1	78	**22.7**	7.9	7.7	**11.4**	0.9	1.5	< MDA	2.34	--	< MDA	103	--
WEIR 5	15-May-97	**5**	0.08	0.9	--	--	--	**5.92**	0.1	1.06	**770**	0.91	139	<MDA	13.9	--	<MDA	2.89	--	**9.6**	0.72	1.74	<MDA	1880	--
WEIR 6		< MDA	3.22	--	< MDA	1.24	--	< MDA	8.21	--	**39.2**	0.2	2.7	**8.05**	2.27	2.58	**1.62**	0.26	0.31	< MDA	0.71	--	**2.83**	1.56	1.31
WEIR 6	15-May-97	**2.65**	0.08	0.56	--	--	--	**2.81**	0.06	0.59	**68.8**	0.1	12.3	**9.17**	5.41	4.57	**2.66**	0.62	0.77	<MDA	1.67	--	**5.98**	4.42	3.93
WEIR 7		< MDA	0.10	--	< MDA	1.72	--	< MDA	0.20	--	**9.00**	0.21	1.87	< MDA	3.08	--	**0.57**	0.38	0.40	< MDA	0.65	--	< MDA	2.34	--
WEIR 7	15-May-97	**1.43**	0.13	0.33	--	--	--	**1.44**	0.11	0.33	**154**	0.25	27	**6.57**	5.4	4.2	**2.09**	0.65	0.73	<MDA	1.78	--	**16.3**	3.6	5.2
WEIR 8		**1.28**	1.28	1.36	< MDA	4.46	--	< MDA	1.28	--	**3.34**	0.14	0.81	< MDA	5.44	--	< MDA	0.72	--	< MDA	0.81	--	< MDA	71.9	--
WEIR 8	15-May-97	**0.79**	0.1	0.21	--	--	--	**0.82**	0.09	0.21	**3.51**	0.09	0.73	<MDA	6.13	--	<MDA	1.05	--	<MDA	1.37	--	<MDA	4.21	--
WEIR 9		< MDA	2.37	--	< MDA	1.97	--	**5.28**	4.62	4.42	**150**	0.1	22	**6.68**	2.19	3.01	**2.59**	0.29	0.38	**2.40**	0.33	0.47	**10.1**	1.7	2.6
WEIR 9	15-May-97	**2.5**	0.06	0.5	--	--	--	**4.06**	0.1	0.75	**1160**	4.98	212	<MDA	13.7	--	**21.8**	0.79	2.8	**18.5**	0.93	2.8	**31.7**	7.5	9.3
SED 1	15-May-97	**3.14**	0.12	0.62	--	--	--	**16.3**	0.09	2.8	**2.71**	0.05	0.56	<MDA	5.08	--	<MDA	1.06	--	<MDA	1.07	--	<MDA	2000	--
SED 1 DUP (F)	15-May-97	**1.17**	0.06	0.26	--	--	--	**1.04**	0.06	0.24	**3.18**	0.07	0.66	<MDA	8.22	--	<MDA	1.26	--	<MDA	1.55	--	<MDA	2640	--
SED 1 DUP (L)	15-May-97	**0.97**	0.02	0.24	--	--	--	**0.95**	0.08	0.24	**2.93**	0.08	0.6	**6.74**	6.86	4.99	**1.72**	0.59	0.57	<MDA	1.46	--	**4.84**	4.16	3.84
SED 2	15-May-97	**0.71**	0.04	0.19	--	--	--	**0.58**	0.06	0.16	**1.7**	0.05	0.37	<MDA	3.9	--	<MDA	0.6	--	<MDA	0.72	--	<MDA	2.22	--
SED 3	15-May-97	**0.78**	0.11	0.19	--	--	--	**0.81**	0.06	0.19	**3.06**	0.07	0.66	<MDA	6.17	--	<MDA	1.12	--	<MDA	1.11	--	<MDA	1980	--
SED 4	15-May-97	**0.53**	0.16	0.18	--	--	--	**0.69**	0.14	0.21	**4.04**	0.1	0.83	**5.4**	2.98	2.82	**0.83**	0.41	0.41	<MDA	1.08	--	<MDA	3.72	--

-- = Not reported.
DUP (F) = Field duplicate
MDA = Minimum Detectable Activity
Bolded numbers indicate result reported above minimum detectable activity.

Table E-2 : Erosional Sediment Analytical Results - Uranium-235 Decay Series

Sample Location	Sample Date	Uranium-235/236			Uranium-235			Protactinium-231			Actinium-227			Radium-223		
		Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error
Site Specific Background (Mean +2)		1.15			--			--			--			--		
Reference Level Concentration		5.15			5			5			5			5		
AREA 1																
WEIR 1		< MDA	0.218	0.01	< MDA	0.70	--	< MDA	3.70	--	< MDA	0.81	--	< MDA	3.56	--
WEIR 1 DUP (F)		--	--	--	< MDA	1.30	--	< MDA	6.48	--	< MDA	1.26	--	< MDA	6.77	--
WEIR 1	15-May-97	**0.12**	0.06	0.08	--	--	--	< MDA	6.29	--	< MDA	1.4	--	< MDA	2.42	--
WEIR 2		< MDA	0.83	0.44	**3.34**	1.60	0.59	**49.9**	8.4	6.8	**30.1**	1.4	3.6	**25.3**	4.0	4.3
WEIR 2 DUP (F)		--	--	--	< MDA	0.76	--	**8.04**	5.66	4.55	**4.00**	0.84	0.83	**3.83**	3.37	1.17
WEIR 2	15-May-97	**0.19**	0.1	0.11	**2.27**		1.39	< MDA	10.7	--	< MDA	3.02	--	**3.65**	0.84	0.78
WEIR 3		< MDA	0.33	0.22	< MDA	0.65	--	< MDA	4.15	--	< MDA	0.83	--	< MDA	4.53	--
WEIR 3 DUP (F)		--	--	--	< MDA	0.56	--	< MDA	3.23	--	< MDA	0.65	--	< MDA	3.70	--
WEIR 3	15-May-97	**0.18**	0.1	0.11	--	--	--	< MDA	5.49	--	< MDA	1.37	--	< MDA	3.7	--
WEIR 4		< MDA	0.239	0.142	< MDA	0.73	--	< MDA	4.44	--	< MDA	0.85	--	< MDA	3.70	--
WEIR 4 DUP (F)		--	--	--	< MDA	0.93	--	< MDA	4.56	--	< MDA	1.03	--	< MDA	4.52	--
WEIR 4	15-May-97	**0.09**	0.11	0.08	--	--	--	< MDA	7.99	--	< MDA	1.83	--	< MDA	3.45	--
AREA 2																
WEIR 5		< MDA	3.50	3.68	< MDA	2.34	--	< MDA	14.2	--	**7.75**	2.25	2.81	< MDA	14.29	--
WEIR 5	15-May-97	**0.65**	0.07	0.19	--	--	--	< MDA	19	--	< MDA	4.51	--	< MDA	26.2	--
WEIR 6		< MDA	6.16	0.30	< MDA	0.61	--	< MDA	4.20	--	< MDA	0.84	--	< MDA	4.13	--
WEIR 6	15-May-97	**0.25**	0.07	0.12	--	--	--	< MDA	9.41	--	< MDA	2.74	--	< MDA	6.51	--
WEIR 7		< MDA	0.27	0.14	< MDA	0.89	--	< MDA	5.63	--	< MDA	1.26	--	< MDA	5.23	--
WEIR 7	15-May-97	**0.17**	0.15	0.11	--	--	--	< MDA	9.99	--	< MDA	2.36	--	< MDA	6.59	--
WEIR 8		< MDA	1.73	0.12	< MDA	1.58	--	< MDA	8.98	--	< MDA	1.90	--	< MDA	7.70	--
WEIR 8	15-May-97	**0.2**	0.07	0.1	--	--	--	< MDA	6.65	--	< MDA	1.59	--	< MDA	2.98	--
WEIR 9		< MDA	5.20	2.18	< MDA	0.63	--	< MDA	4.15	--	< MDA	0.71	--	< MDA	4.79	--
WEIR 9	15-May-97	**0.28**	0.07	0.12	**6.05**	2.34	3.14	< MDA	16.3	--	**5.72**	2.49	2.41	**4.4**	1.19	1.14
SED 1	15-May-97	**1.29**	0.11	0.32	--	--	--	< MDA	8.85	--	< MDA	2.23	--	< MDA	11	--
SED 1 DUP (F)	15-May-97	**0.093**	0.048	0.06	--	--	--	< MDA	8.79	--	< MDA	2.83	--	< MDA	13	--
SED 1 DUP (L)	15-May-97	**0.14**	0.03	0.08	--	--	--	< MDA	10.7	--	< MDA	2.18	--	< MDA	4.6	--
SED 2	15-May-97	**0.068**	0.062	0.055	--	--	--	< MDA	5.84	--	< MDA	1.16	--	< MDA	2.56	--
SED 3	15-May-97	**0.14**	0.09	0.08	--	--	--	< MDA	8.8	--	< MDA	2.69	--	< MDA	11.2	--
SED 4	15-May-97	**0.07**	0.15	0.09	--	--	--	< MDA	5.9	--	< MDA	1.27	--	< MDA	2.46	--

-- = Not reported
DUP (F) = Field duplicate
MDA = Minimum Detectable Activity
Bolded numbers indicate results reported above minimum detectable activity.

Table E-3 : Erosional Sediment Analytical Results - Thorium-232 Decay Series

Sample Location	Sample Date	Thorium-232			Radium-228			Thorium-228			Radium-224			Lead-212			Bismuth-212			Thallium-208		
		Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error	Result	MDA	2 Sigma Error
Site Specific Background (Mean +2)		2.76			2.37			0.88			--			2.26			--			0.71		
Reference Level Concentration		7.76			7.37			5.88			5			7.26			5			5.71		
AREA 1																						
WEIR 1		**0.29**	0.12	0.19	< MDA	0.67	--	< MDA	0.28	0.19	< MDA	3.36	--	**0.30**	0.20	0.15	< MDA	1.46	--	< MDA	0.19	--
WEIR 1 DUP (F)		--	--	--	< MDA	1.03	--	--	--	--	< MDA	4.55	--	**0.45**	0.26	0.37	< MDA	1.66	--	< MDA	0.33	--
WEIR 1	15-May-97	**0.33**	0.05	0.12	< MDA	1.12	--	**0.3**	0.14	0.13	--	--	--	**0.4**	0.32	0.37	< MDA	2.89	--	< MDA	0.23	--
WEIR 2		**3.68**	2.45	2.56	< MDA	1.32	--	< MDA	3.03	1.59	< MDA	7.64	--	**0.97**	0.38	0.30	< MDA	2.07	--	**0.62**	0.24	0.27
WEIR 2 DUP (F)		--	--	--	< MDA	0.98	--	--	--	--	< MDA	3.68	--	**0.84**	0.22	0.23	< MDA	1.71	--	**0.32**	0.15	0.20
WEIR 2	15-May-97	**1.83**	0.08	0.43	< MDA	1.84	--	**1.08**	0.13	0.29	--	--	--	**0.95**	0.43	0.39	< MDA	5.85	--	**0.4**	0.29	0.36
WEIR 3		**0.56**	0.17	0.56	< MDA	0.83	--	**0.40**	0.21	0.40	< MDA	3.53	--	**0.29**	0.20	0.18	< MDA	1.60	--	< MDA	0.22	--
WEIR 3 DUP (F)		--	--	--	< MDA	0.80	--	-	--	--	< MDA	2.48	--	**0.22**	0.19	0.14	< MDA	1.53	--	< MDA	0.21	--
WEIR 3	15-May-97	**0.79**	0.02	0.22	< MDA	1.7	--	**0.87**	0.12	0.24	--	--	--	**0.82**	0.33	0.35	< MDA	7.13	--	< MDA	0.49	--
WEIR 4		**0.88**	0.14	0.32	**1.15**	0.86	0.44	**0.76**	0.17	0.30	< MDA	4.87	--	**1.15**	0.20	0.21	< MDA	1.54	--	**0.48**	0.17	0.16
WEIR 4 DUP (F)		--	--	--	< MDA	1.14	--	-	--	--	< MDA	2.65	--	**1.00**	0.22	0.26	< MDA	1.57	--	**0.41**	0.18	0.16
WEIR 4	15-May-97	**1.29**	0.07	0.33	< MDA	1.84	--	**1.37**	0.08	0.34	--	--	--	**1.47**	0.39	0.51	< MDA	5.18	--	< MDA	0.53	--
AREA 2																						
WEIR 5		**3.37**	0.09	0.79	< MDA	1.60	--	**0.45**	0.12	0.20	< MDA	10.13	--	< MDA	0.90	--	< MDA	3.27	--	< MDA	0.50	--
WEIR 5	15-May-97	**4.82**	0.28	1.66	< MDA	1.62	--	**0.56**	0.91	0.57	--	--	--	< MDA	1.19	--	< MDA	5.57	--	< MDA	0.46	--
WEIR 6		**1.54**	0.15	0.44	**1.15**	0.67	0.51	**0.89**	0.13	0.31	< MDA	3.09	--	**0.99**	0.20	0.20	< MDA	1.62	--	**0.37**	0.14	0.17
WEIR 6	15-May-97	**2.09**	0.1	0.47	< MDA	1.86	--	**1.29**	0.1	0.32	--	--	--	< MDA	0.94	--	< MDA	6.29	--	**0.49**	0.31	0.38
WEIR 7		**0.97**	0.21	0.32	< MDA	1.21	--	**2.03**	0.16	0.54	< MDA	4.34	--	**1.15**	0.21	0.32	< MDA	1.90	--	< MDA	0.20	--
WEIR 7	15-May-97	**0.94**	0.25	0.46	< MDA	2.02	--	**0.57**	0.62	0.41	--	--	--	**0.78**	0.44	0.35	< MDA	6.05	--	< MDA	0.55	--
WEIR 8		**0.16**	0.10	0.12	< MDA	1.37	--	**1.37**	0.14	0.42	< MDA	5.82	--	< MDA	0.51	--	< MDA	2.80	--	< MDA	0.41	--
WEIR 8	15-May-97	**0.86**	0.07	0.24	< MDA	1.87	--	**0.72**	0.08	0.21	--	--	--	< MDA	0.69	--	< MDA	4.83	--	< MDA	0.49	--
WEIR 9		**1.94**	0.11	0.49	< MDA	1.04	--	**47.8**	0.15	0.21	< MDA	2.14	--	**0.59**	0.19	0.18	< MDA	1.77	--	**0.30**	0.17	0.18
WEIR 9	15-May-97	**22.6**	3.66	8	< MDA	2.09	--	**2.08**	6.71	3.23	--	--	--	< MDA	0.98	--	< MDA	6.32	--	< MDA	0.49	--
SED 1	15-May-97	**0.47**	0.05	0.15	< MDA	1.44	--	**0.56**	0.09	0.17	--	--	--	**0.7**	0.63	0.44	< MDA	5.34	--	< MDA	0.42	--
SED 1 DUP (F)	15-May-97	**0.52**	0.06	0.17	< MDA	1.94	--	**0.65**	0.07	0.2	--	--	--	< MDA	0.69	--	< MDA	7.17	--	< MDA	0.52	--
SED 1 DUP (L)	15-May-97	**0.57**	0.1	0.18	< MDA	2.41	--	**0.65**	0.1	0.19	--	--	--	< MDA	0.84	--	< MDA	5.23	--	< MDA	0.5	--
SED 2	15-May-97	**0.24**	0.05	0.1	< MDA	0.85	--	**0.2**	0.07	0.09	--	--	--	< MDA	0.38	--	< MDA	3.22	--	< MDA	0.28	--
SED 3	15-May-97	**0.92**	0.06	0.26	< MDA	1.68	--	**1.17**	0.11	0.31	--	--	--	< MDA	0.91	--	< MDA	5.89	--	< MDA	0.57	--
SED 4	15-May-97	**0.84**	0.13	0.24	< MDA	1.83	--	**0.74**	0.09	0.22	--	--	--	**0.84**	0.4	0.33	< MDA	4.4	--	< MDA	0.21	--

-- = Not reported

DUP (F) = Field duplicate

MDA = Minimum Detectable Activity

Bolded numbers indicate result reported above minimum detectable activity.

Table E-4 : Erosional Sediment Analytical Results - Priority Pollutant Metals and Cyanide

Weir Number	Arsenic	Beryllium	Cadmium	Chromium	Copper	Lead	Nickel	Selenium	Zinc
	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)
Area 1									
1	**1.5**	*< 0.75*	*< 1.5*	**7.2**	**11**	**17**	**6**	*< 0.25*	**49**
2	**4.1**	**0.35**	*< 0.50*	**8.2**	**61**	**18**	**130**	**1.5**	**30**
3	**0.90**	*< 0.75*	*< 1.5*	**5.3**	**6.0**	**7.7**	**5.8**	*< 0.25*	**28**
4	**1.9**	**0.56**	*< 0.50*	**10**	**6.6**	**7.8**	**10**	*< 0.25*	**20**
Area 2									
5	**2.7**	*< 1.0*	*< 2.0*	**9.5**	**28**	**60**	**23**	**0.68**	**95**
6	**1.8**	**0.64**	*< 0.50*	**17**	**20**	**17**	**22**	**0.42**	**63**
7	**2.7**	**0.34**	**0.61**	**16**	**31**	**21**	**16**	*< 0.25*	**56**
8	**2.2**	*< 1.0*	*< 2.0*	**8.6**	**6.7**	*< 10*	**7.3**	*< 0.25*	**34**
9	**2.1**	*< 1.0*	*< 2.0*	**9.1**	**7.6**	**13**	**9**	*< 0.25*	**30**

< = Result reported below the reporting limit
Erosional sediment samples were additionally analyzed for Total Cyanide (USEPA Method 9010) , Mercury (USEPA Method SW846-7471),
and Thallium (USEPA Method SW846-7841). None of these compounds were detected.
Bold numbers indicate result reported above the method detection limit.

Table E-5 : Erosional Sediment Analytical Results - Total Petroleum Hydrocarbons, Semivolatile Organic Compounds, Pesticides, and Polychlorinated Biphenyls

Total Petroleum Hydrocarbons

Weir Number	Motor Oil Range
	Result (ppm)
Area 1	
1	**50**
2	**580**
3	**50**
4	*< 10*
Area 2	
5	**53**
6	*< 10*
7	*< 10*
8	*< 10*
9	*< 10*

< = Result reported below the reporting limit

Bold numbers indicate result reported above the method detection limit.

Semivolatile Organic Compounds

Weir Number	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Chrysene	Fluoranthene	Bis(2-Ethylhexyl)phthalate
	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)
Area 1						
1	**0.093 J**	**0.069 J**	**0.089 J**	**0.078 J**	**0.16 J**	**0.86**
2	*< 1.70*	*< 1.70*	*< 1.70*	*< 1.70*	*< 1.70*	**5.8**
3	**0.048 J**	**0.040 J**	**0.035 J**	**0.038 J**	**0.055 J**	**1.4**
4	*< 0.33*	*< 0.33*	*< 0.33*	*< 0.33*	*< 0.33*	*< 0.33*
Area 2						
5	*< 0.33*	*< 0.33*	*< 0.33*	*< 0.33*	*< 0.33*	*< 0.33*
6	*< 0.33*	*< 0.33*	*< 0.33*	*< 0.33*	*< 0.33*	*< 0.33*
7	**1.2**	**1.2**	**1.3**	**1.5**	**1.8**	*< 0.33*
8	*< 0.33*	*0.33*	*< 0.33*	*< 0.33*	*< 0.33*	*< 0.33*
9	*< 0.33*	*< 0.33*	*< 0.33*	*< 0.33*	*< 0.33*	*< 0.33*

< = Result reported below the reporting limit.

MDOH ASL = Missouri Department of Health Any-Use Soil Levels for Clean-up Assessments (Division of Environmental Quality, April 1995)

J = Estimated value. Result was below the reporting limit.

Pyrene was only detected in the samples corresponding to Weir Number 1 (0.15 J ppm) and Weir Number 7 (1.4 ppm).

Benzo(a)anthracene was only detected in the samples corresponding to Weir Number 1 (0.067 J ppm) and Weir Number 7 (1.2 ppm).

Benzo(g,h,i)perylene was only detected in the samples corresponding to Weir Number 1 (0.061 J ppm).

Indeno(1,2,3-c,d)pyrene was only detected in the samples corresponding to Weir Number 1 (0.062 J ppm) and Weir Number 7 (0.42 ppm).

Phenanthrene was only detected in the samples corresponding to Weir Number 1 (0.091 J ppm) and Weir Number 7 (0.72 ppm).

Bold numbers indicate result reported above the method detection limit.

Pesticides and Polychlorinated Biphenyls

Weir Number	Pesticides			
	Aldrin	delta-BHC	Endosulfan I	Heptachlor Epoxide
	Result (ppm)	Result (ppm)	Result (ppm)	Result (ppm)
Area 1				
1	**0.00082**	*< 0.00034*	*< 0.00034*	*< 0.00034*
2	*< 0.00034*	**0.00034**	**0.00040**	*< 0.00034*
3	**0.00058**	*< 0.00034*	*< 0.00034*	*< 0.00034*
4	*< 0.00034*	*< 0.00034*	*< 0.00034*	*< 0.00034*
Area 2				
5	*< 0.00033*	*< 0.00033*	*< 0.00033*	**0.0025**
6	*< 0.00033*	*< 0.00033*	*< 0.00033*	*< 0.00033*
7	*< 0.00033*	*< 0.00033*	*< 0.00033*	*< 0.00033*
8	*< 0.00033*	*< 0.00033*	*< 0.00033*	*< 0.00033*
9	*< 0.00033*	*< 0.00033*	*< 0.00033*	*< 0.00033*

< = Result reported below the reporting limit

MDOH ASL = Missouri Department of Health Any-Use Soil Levels for Clean-up Assessments (Division of Environmental Quality, April 1995)

NE = Not established

No Polychlorinated Biphenyl Aroclors were detected.

Bold numbers indicate result reported above the method detection limit.